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DEPARTMENT OF THE INTERIOR

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OF THE

UNITED STATES

GEOLOGICAL SURVEY

No. 122

WASHINGTON
GOVERNMENT PRINTING OFFICE
1894

UNITED STATES GEOLOGICAL SURVEY

J. W. POWELL, DIRECTOR

RESULTS
OF
PRIMARY TRIANGULATION

BY

HENRY GANNETT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1894

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
U. S. GEOLOGICAL SURVEY, DIVISION OF GEOGRAPHY,
Washington, D. C., June 30, 1894.

SIR: I have the honor to transmit herewith, in form for publication, the results of the primary triangulation executed by the U. S. Geological Survey during the past twelve years—that is, since the commencement of work upon the topographic atlas of the United States.

The work of compiling this bulletin has been executed by Messrs. H. M. Wilson, R. U. Goode, and S. S. Gannett.

Very respectfully submitted,

HENRY GANNETT,
Chief Topographer.

Hon. J. W. POWELL,
Director U. S. Geological Survey.

RESULTS OF PRIMARY TRIANGULATION.

By HENRY GANNETT.

INTRODUCTION.

The triangulation of the U. S. Geological Survey is executed solely for the primary control of topographic work upon scales not exceeding 1:62500. The extreme of accuracy has therefore not been sought, but only such a degree of accuracy as to insure that the maximum accumulated error be imperceptible upon the maps.

Wherever work has been done by other organizations, which is of sufficient accuracy for the control of the maps of this organization, such work has been utilized both immediately for the location of topographic work and also for the extension of triangulation therefrom by this organization. The work of the U. S. Coast and Geodetic Survey has been largely used in this manner, especially in the eastern part of the country. The maps in New England, New York, New Jersey, and Pennsylvania rest in large part directly upon the points determined by this organization, while in the Appalachian region, triangulation has been extended by this organization from points determined by the U. S. Coast and Geodetic Survey. The work of the U. S. Lake Survey and also that of the New York State survey has been extensively utilized in a similar manner, as is fully set forth in the descriptions accompanying the different groups of results. In the interior of the country and in the Far West, work has been done ab initio by this Survey. Astronomical determinations of positions have been made, base lines have been measured and expansions effected by it.

The results have been arranged in chapters by geographical groups, the arrangement being as natural as possible, and as an introduction to each chapter there is given a description of the work, outlining the methods employed and instruments used, and stating by whom the work was done.

The groups into which the work is arranged are as follows:

NEW ENGLAND:

The triangulation of the U. S. Coast and Geodetic Survey covers the entire coast of Maine and extends far inland. It covers most of New Hampshire and much of Vermont, while practically the entire areas of the remaining States of this group are covered by its primary stations.

In Massachusetts the numerous stations of the Borden survey ha been adjusted by the U. S. Coast and Geodetic Survey to agreeme with its own positions, and have thus become available for use. O side of Massachusetts the stations of the U. S. Coast and Geodetic S vey are, as a rule, far apart, and much work of a supplementary charact has been found necessary, in order to obtain enough points for instit ting plane-table triangulation. This work of supplementing the t angulation of the U. S. Coast and Geodetic Survey has been execut by Messrs. S. S. Gannett and R. U. Goode.

NEW YORK, NEW JERSEY, AND PENNSYLVANIA:

In New York a large amount of triangulation has been executed the U. S. Coast and Geodetic Survey. Its work extended from Ne York Harbor up the Hudson and through Lake Champlain and up t Mohawk Valley to a connection with the U. S. Lake Survey ne Oswego. Triangulation has been extended along the shores of Lak Erie and Ontario by the U. S. Lake Survey. The New York Sta survey, under Mr. J. T. Gardiner, starting from points near the Hudso determined by the U. S. Coast and Geodetic Survey, has been extende westward to the foot of Lake Erie and southward across the middle the State to the Pennsylvania line.

The entire area of New Jersey has been closely covered by triangul tion by the U. S. Coast and Geodetic Survey, and the New Jerse Geological Survey.

The work of the U. S. Coast and Geodetic Survey extends over large part of eastern Pennsylvania.

In New York and Pennsylvania it has been found necessary to ex cute much supplementary triangulation, both for the purpose of su plying more points in areas already covered by triangulation and in th extension of triangulation into new areas. In all this work, as in Ne England, the work of other organizations, above specified, has fu nished the base lines. The work in these States has been executed b Mr. S. S. Gannett.

SOUTHERN APPALACHIAN REGION:

The U. S. Coast and Geodetic Survey has carried a belt of large fig ures from the head of Chesapeake Bay southwestward to central Ala bama, along the east front of the Appalachian Mountain system. Th lines of this belt have served as a series of base lines for the extensio of triangulation by the U. S. Geological Survey westward and north ward over the mountain region. This work has been going forward fo a number of years and has been executed by several different men. I was instituted by Prof. W. C. Kerr, while most of it has been done b Mr. S. S. Gannett. Others who have contributed to it are Prof. J. H Gore, Mr. C. M. Yates, Mr. W. T. Griswold, and Mr. F. J. Knight.

The text accompanying the descriptions and positions of points i New England, New York, New Jersey, and Pennsylvania, and th southern Appalachian region has been prepared by Mr. S. S. Gannett

HIGAN:

A small area of triangulation has been executed by Mr. F. J. Knight n the upper peninsula of Michigan, extending westward from Mar- tte. It rests upon two stations determined by the U. S. Lake Sur- near Marquette.

ANSAS:

he work in Arkansas depends upon two base lines located respectively r Fort Smith and Little Rock. It was executed by Messrs. S. S. Gan- t and G. T. Hawkins. A description has been prepared by the first- ed gentleman.

NSAS:

he work in Kansas consists practically of two belts of triangulation ning westward in different latitudes nearly across the State. They pend upon stations in western Missouri and eastern Kansas in the scontinental belt of triangulation of the U. S. Coast and Geodetic rvey. The work was executed by Messrs. R. U. Goode, J. H. Ren- we, and H. L. Baldwin, and the text has been prepared by Mr. dwin.

AS:

he work in Texas is in two isolated parts. One extended area occu- the central part of the State, while the other, much more restricted, n the Trans-Pecos region. The first rests upon two base lines, one ar Austin, the other near Cisco. This triangulation was executed Messrs. R. U. Goode, E. M. Douglas, and C. F. Urquhart.

hat in the Trans-Pecos region rests upon a base near El Paso. The rk was done by Messrs. R. U. Goode, A. P. Davis, and C. F. Urqu- rt. The text relating to the Texas work has been prepared by Mr. ode.

ACK HILLS OF SOUTH DAKOTA:

his body of triangulation rests upon a base measured near Rapid ty. The work was done by Mr. E. M. Douglas, who has prepared e text relating to it.

PEN, COLO.:

A little triangulation has been done in the neighborhood of this ning camp, resting upon points determined by the Hayden Survey. e work was done by Messrs. E. M. Douglas and Morris Bien.

YOMING:

In southern Wyoming a little triangulation has been done for the ntrol of work in the neighborhood of Laramie. This was extended m a measured base by Mr. Frank Tweedy.

ONTANA:

The triangulation in Montana and northwestern Wyoming rests on a base line measured near Bozeman. From this base triangula- n has been extended southward over the Yellowstone Park and the untry east thereof, and westward over the upper waters of the Missouri River. The work was done by Messrs. J. H. Renshawe, E. M. Douglas, and Frank Tweedy. The descriptive text has been written by Mr. Tweedy.

IDAHO:

A base measured near Boise serves as the beginning of this work. The triangulation has been done by Mr. W. T. Griswold and the description of it was written by Mr. E. T. Perkins.

CALIFORNIA:

The work in California is in two parts, an extended area in central and northern California, extending northward into southwest Oregon, and a much smaller area in the neighborhood of Los Angeles and San Diego. The former of these areas rests upon stations of the U. S. Coast and Geodetic Survey. The work has been executed by a number of different men, Messrs. Gilbert Thompson, Mark B. Kerr, H. M. Wilson, E. M. Douglas, and H. E. C. Feusier. This work has been described by Mr. Douglas.

The work in southern California rests upon a base measured by the U. S. Coast and Geodetic Survey. It has been executed by Mr. A. P. Davis, and is described by him.

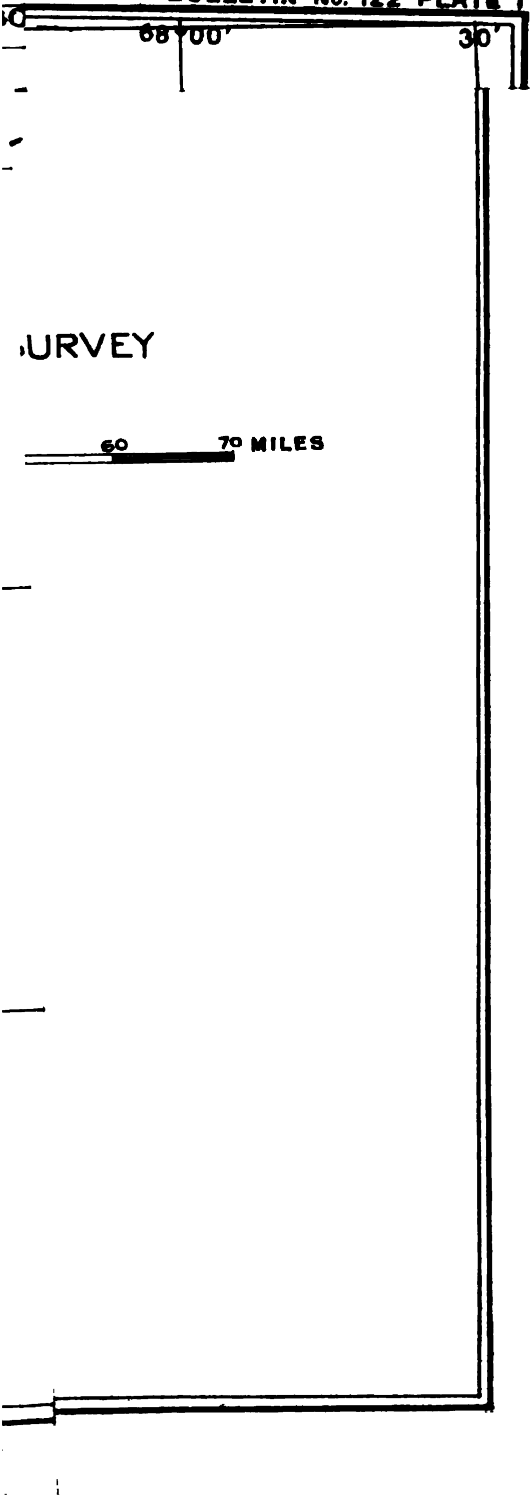
THE PLATEAU REGION:

The work in the Plateau region of New Mexico and Arizona rests upon a base measured near Fort Wingate, whence it has been extended eastward and westward. This work was done by Messrs. Gilbert Thompson, A. P. Davis, F. J. Knight, and H. M. Wilson. The description was prepared by Mr. Davis.

The triangulation executed by early surveys in the West, known as the Hayden, the Powell, and the Wheeler surveys, has been utilized to some extent for the control or initiation of work; that of the Wheeler but little, and that of the Hayden to a greater extent, especially in Colorado. That of the Powell survey, the results of which have never heretofore been published, has been used very largely, inasmuch as the maps prepared by that organization have been published as atlas sheets by this Survey. These cover nearly all of Utah and northern Arizona, and it has seemed proper in this publication to include a description of this work and the positions of the points determined by it in extenso. A description of this work will be found in its proper place, written by Mr. A. H. Thompson, who, with Mr. G. K. Gilbert, executed the work.

All positions herewith presented are referred to the Clarke spheroid of revolution of 1866; the unit of length is the iron committee meter brought to this country by Hassler, and now in the possession of the Bureau of Weights and Measures. In the Northeastern States, the positions are referred to the mean positions of the U. S. Coast and Geodetic Survey; elsewhere they are, as stated in the text accompanying the various groups of work, referred to isolated astronomical determinations, which are, of course, subject to unknown station errors.

BULLETIN No. 122 PLATE I



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NEW ENGLAND.

METHODS OF WORK.

MAINE.

The triangulation in southwestern Maine executed in 1888 was based upon two stations of the U. S. Coast and Geodetic Survey, Ossipee and Independence; a third, Agamenticus, was occupied, but the station mark could not be identified and a new point was established. From these stations thirteen others in York and Cumberland counties, distributed over seven atlas sheets, were located.

In 1890 a system of quadrilaterals was extended from Sabattus-Blin, stations of the U. S. Coast and Geodetic Survey, up the Kennebec Valley about 45 miles; twelve stations, distributed over five atlas sheets, were located. Isolated, bare hills favorably located for topographic purposes were generally utilized. A tripod signal of simple form was used, the materials for which were generally obtainable at the nearest farmhouse.

Angles were measured by S. S. Gannett with a Fauth 8-inch theodolite, reading by micrometer microscopes to two seconds of arc. Local or station adjustment was made in most cases, but figure adjustment was not considered necessary and has not been made.

NEW HAMPSHIRE.

In 1892 the triangulation of the U. S. Coast and Geodetic Survey in the White Mountain region was supplemented by cutting in additional points. Mounts Washington, Kearsarge, and Lafayette were used as initial points, and three other stations were occupied; altogether, eleven points, furnishing control for four atlas sheets, were located.

Angles were measured with a Fauth 8-inch theodolite by S. S. Gannett and B. C. Washington, jr. Adjustment of figures by least squares was not made.

MASSACHUSETTS.

Eleven new stations, controlling four atlas sheets, were located in Worcester County in 1887 by Mr. R. U. Goode. The lines Wachusett-Watatic and Wachusett-Fay, established by the U. S. Coast and Geodetic Survey, were used as bases.

Lone trees on bare hills were utilized as signals.

Angles were measured with the Gambey 11-inch theodolite, reading by verniers to ten seconds. This work was not adjusted.

RHODE ISLAND.

The western portion of Rhode Island was controlled during 1888 by triangulation extended from the lines of the U. S. Coast and Geodetic Survey, Beaconpole-Spencer, Spencer-Sherman, and Sherman-Champlin. This work was slow and difficult. The hills being of about the same height and heavily wooded, the building of high scaffolds was necessary. A tall tree was usually selected, its branches cut off, and the trunk used as one leg of a triangular scaffold.

Angles were measured with a light 6-inch theodolite mounted on its own tripod on the floor of the scaffold from 40 to 60 feet above the ground.

This work was done by Mr. R. U. Goode and Mr. C. F. Urquhart. No least square adjustments were made.

CONNECTICUT.

Control for north central Connecticut was obtained by extending triangulation from the U. S. Coast and Geodetic Survey stations Good Hill, Mount Tom, and Ivy, in Litchfield and Hartford counties, and from Box Hill and Bald Hill in Tolland, Windham, and New London counties.

Seventeen stations, controlling ten atlas sheets, were located in 1889. Isolated, cleared hills were usually available, and were selected as stations. Various forms of signals were used, the usual form being a tripod under which the theodolite was centered.

Angles were measured with a Fauth 8-inch theodolite, reading by micrometer to two seconds, by S. S. Gannett.

A least square adjustment of the angles was made at each station, but no figure adjustment was made.

DESCRIPTIONS AND POSITIONS OF STATIONS.

BIGELOW.

Four miles south of the village of Skowhegan, Somerset Co., Me., on land owned by J. W. Packard. Summit entirely cleared of trees.

Permanent mark: Iron bolt in solid ledge.

[Latitude. 44° 42′ 47″·91. Longitude, 69° 43′ 39″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bowman	353	10	30·0	173	11	42·8	4·282315
Quaker	6	59	15·0	186	57	15·0	4·492396
Hornbeam	34	02	10·9	213	52	45·1	4·502702
Março	335	05	23·8	155	08	47·5	4·181320

MARCO.

Situated in pasture owned by Peter Marco, on highest part of hill, 2½ miles north-northwest of Waterville, in southern edge of town of Fairfield, Somerset Co., Me.

Permanent mark: A pole 25 feet high with flag at top and four boards nailed across 12 to 15 feet from ground.

[Latitude, 44° 35′ 21″·72. Longitude, 69° 38′ 49″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bowman	38	09	29·4	218	07	18·3	3·824352
Bigelow	155	08	47·5	335	05	23·8	4·181320
Quaker							4·298319

BOWMAN.

In Oakland, Kennebec Co., Me., on a flat, cleared hill, 1½ miles east of village. Land owned by Mr. Bowman, who lives one-eighth of a mile from triangulation point.

Permanent mark: A pole 25 feet high, with white flag at top and boards nailed across just above braces.

[Latitude, 44° 32′ 31″·67. Longitude, 69° 41′ 56″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Quaker	27	08	44·9	207	05	32. 9	4·123305
Hornbeam	69	55	40·1	249	45	02·9	4·330181
Marco	218	07	18·3	38	09	29·4	3·824352
Bigelow	173	11	42·8	353	10	30·0	4·282315

HORNBEAM.

In Kennebec Co., Me., on a cleared hill 2½ miles southeast of the village of Mount Vernon and 14 miles from Augusta, a few trees standing on eastern edge of the hill. Station not on highest part of hill, but on ground 4 or 5 feet lower than and 200 feet south of highest part.

Permanent mark: A rock pile 4 feet high.

[Latitude, 44° 28′ 32″·84. Longitude, 69° 57′ 05″·58.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Quaker	287	31	48·4	107	39	14·7	4·168100
Winter	322	02	14·2	142	11	04·1	4·436338
Pisgah	17	08	40·6	197	05	37·3	4·294608
Bowman	249	45	02·9	69	55	40·1	4·330181
Bigelow	213	52	45·1	34	02	10·9	4·502702

QUAKER.

In Sidney, Kennebec Co., Me., on a high cleared ridge, 10 miles from Augusta. An old schoolhouse stands on top of ridge, 174.2 feet south of station. Station is on highest part, on land owned by L. B. Ward. A wagon road passes 50 feet east of station.

Permanant mark: Iron bolt in soft rock, arrowheads cut in ledge pointing to center.

[Latitude, 44° 26′ 08″·63. Longitude, 69° 46′ 30″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Winter	350	57	38·6	170	59	04·4	4·238470
Pisgah	54	10	38·3	234	00	11·0	4·389549
Sabattus							4·607323
Hornbeam	107	39	14·7	287	31	48·4	4·168100
Bowman	207	05	32·9	27	08	44·9	4·123305
Bigelow	186	57	15·0	6	59	15·0	4·492396

PISGAH.

In Kennebec Co., Me., on a high bare hill in southwestern part of Winthrop. C. B. Stanton lives on south end of hill, 4 miles from Winthrop village and 1 mile from triangulation point.

Permanent mark: A rock cairn 10 feet high, on most northern and highest summit.

[Latitude, 44° 18′ 22″·67. Longitude, 70° 01′ 27″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sabattus	13	34	24·4	193	32	07·7	4·268767
Hornbeam	197	05	37·3	17	08	40·6	4·294608
Blin	306	48	44·1	127	03	05·6	4·535429
Winter	276	45	46·0	96	57	38·1	4·357368
Quaker	234	00	11·0	54	10	38·3	4·389549

WINTER.

Triangulation station of the U. S. C. & G. S. in Chelsea, Kennebec Co., Me., 4 miles by road southeast of Augusta. Trees stand on northern and eastern sides of hill, with an unobstructed view in other directions.

Permanent mark: Copper bolt in ledge.

[Latitude, 44° 16′ 54″·54. Longitude, 69° 44′ 27″·94.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sabattus	60	31	18·9	240	17	11·1	4·491934
Pisgah	96	57	38·1	276	45	46·0	4·357368
Hornbeam	142	11	04·1	322	02	14·2	4·436338
Quaker	170	59	04·4	350	57	38·6	4·238470

SABATTUS.

Triangulation station of the U. S. C. & G. S. in Androscoggin Co., Me., 4 miles from Leeds Junction, and in the town of Wales. Summit is bare with the exception of a few trees on eastern edge.

Permanent mark: Copper bolt in solid ledge.

[Latitude, 44° 08′ 37″·83. Longitude, 70° 04′ 43″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blin	274	28	12·85	94	44	49·62	4·5041408
Independence	24	31	22·95	204	21	18·70	4·6713784
Pisgah	193	32	07·70	13	34	24·40	4·268767
Winter	240	17	11·10	60	31	18·90	4·491934
Monks Hill	212	56	34·00	33	04	45·00	4·45716

BLIN.

Triangulation station of the U. S. C. & G. S. in Dresden, Lincoln Co., Me. It is on a flat hill owned by Zina Blin, timbered on eastern side and view to north interrupted by orchard and buildings.

Permanent mark: Hole drilled in ledge and rock piled around.

[Latitude, 44° 07′ 14″·72. Longitude, 69° 40′ 52″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pisgah	127	08	05·60	306	48	44·10	4·535429
Sabattus	94	44	49·62	274	28	12·85	4·5041408
Monks Hill	148	47	48·00	328	39	20·00	4·49292

MONKS HILL.

Not occupied. A high bare hill in Readfield, Kennebec Co., Me., 7 miles northwest of Augusta. A chestnut tree still standing on western edge of summit.

Permanent mark: A pile of rocks.

[Latitude, 44° 21′ 36″·25. Longitude, 69° 58′ 00″·15.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blin	328	39	20	148	47	48	4·49292
Sabattus	33	04	45	212	56	34	4·45716

ADAMS.

In West Gray, Cumberland Co., Me. Station is on roof of house of Silas Adams. on a flat cleared ridge.

Permanent mark: Center of white cupola of house.

[Latitude, 43° 52′ 53″·95. Longitude, 70′ 23′ 28″·51.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gorham	11	25	34	191	23	15	4·357428
Sawyer	62	31	11	242	19	08	4·517042

INDEPENDENCE.

Triangulation station of the U. S. C. & G. S. in Falmouth, Cumberland Co., Me., 8 miles north of Portland; hill entirely cleared of timber.

Permanent mark: An earthen cone buried about 3 feet below surface.

[Latitude, 43° 45′ 33″·75. Longitude, 70° 19′ 14″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sabattus	204	21	18·70	24	31	22·95	4·6713784
Pleasant	126	33	00·63	306	12	07·39	4·6999260
Agamenticus	26	55	50·74	206	40	29·47	4·824134
Ossipee	60	54	23·53	240	36	58·50	4·5894007
Sawyer	87	28	35·00	267	10	37·00	4·542959
Munjoy	330	56	38·00	150	59	37·00	4·076807

MUNJOY.

Station in the observatory, 80 feet high, on Munjoy Hill, Portland, Cumberland Co., Me., owned by John W. York.

Permanent mark: Center of observatory.

[Latitude, 43° 39′ 55″·64. Longitude, 70° 14′ 55″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ossipee	78	02	09	257	41	46	4·608904
Independence	150	59	37	330	56	38	4·076807

GORHAM.

Normal school, Gorham, Cumberland Co., Me.

Permanent mark: Center of tallest tower on building.

[Latitude, 43° 40′ 50″·60. Longitude, 70° 26′ 49″·96.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ossipee	66	44	49	246	32	39	4·412059
Sawyer	106	10	11	285	57	29	4·409907
Adams	191	23	15	11	25	34	4·357428

SAWYER.

In York Co., Me. A bald and grassy ridge on line between Limington and Limerick, owned by A. W. Sawyer, who lives one-fourth of a mile below summit on southwest side.

Permanent mark: A rock cairn 7 feet square at base, tapering to 3 feet square at top, and 14 feet high.

[Latitude, 43° 44′ 41″·00. Longitude, 70° 45′ 13″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Independence....	267	10	37	87	28	35	4·542959
Ossipee............	356	38	25	176	38	56	4·240003
Gorham	285	57	29	106	10	11	4·409907
Adams............	242	19	08	62	34	11	4·517042

OSSIPEE.

Triangulation station of the U. S. C. & G. S. in York Co., Me., 2 miles from Waterboro. Summit cleared of timber. Land owned by Thomas Smith, who lives on side of mountain one-half mile from triangulation point.

Permanent mark: A copper bolt in solid rock.

[Latitude, 43° 35′ 18″·87. Longitude, 70° 44′ 27″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Agamenticus.....	354	26	44·96	174	28	45·04	4·6101160
Independence	240	36	58·50	60	54	23·53	4·5894007
Bauneg Beg	8	59	31·00	188	57	41·00	4·361474
Farnham	57	42	32·00	237	34	44·00	4·256611
Sawyer	176	38	56·00	356	38	25·00	4·240003
Gorham	246	32	39·00	66	44	49·00	4·412050
Munjoy...........	257	41	46·00	78	02	09·00	4·608904

FARNHAM.

On a ridge owned by Horace Farnham, in town of Acton, about midway between Milton Mills and South Acton, York Co., Me.

Permanent mark: A tall Lombardy poplar tree in field south of barn.

[Latitude, 43° 30′ 05″·77. Longitude, 70° 55′ 47″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ossipee............	237	34	44	57	42	32	4·256611
Bauneg Beg	318	04	47	138	10	44	4·243370

BAUNEG BEG.

In the town of North Berwick, York Co., Me., 7 miles northwest from the depot. The station is on the highest of the three summits. Several acres of timber were cut down, but much is still standing on the western side of the hill.

Permanent mark: A pine tree, shaped like a lyre; trimmed up.

[Latitude, 43° 23′ 03″·18. Longitude, 70° 47′ 07″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ossipee	188	57	41	8	59	31	4·361474
Agamenticus	337	03	22	157	07	12	4·287596
Farnham	138	10	44	318	04	47	4·243370
Tare Shirt	23	13	31	203	11	59	3·882960

AGAMENTICUS.

Triangulation station of the U. S. C. & G. S., about 12 miles from Portsmouth, N. H., in York Township, about midway between York Corner and North Berwick, York Co., Me. Summit cleared of timber except on west and northwest sides.

Permanent mark: A rock cairn 8 feet square, 15 feet high, 28 feet northwest of signal.

[Latitude, 43° 13′ 24″·63. Longitude, 70° 41′ 32″·91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Independence	206	40	29·47	26	55	50·74	4·824184
Bauneg Beg	157	07	12·00	337	03	22·00	4·287596
Ossipee	174	28	45·04	354	26	44·96	4·6101160
Tare Shirt	135	48	57·00	315	43	36·00	4·18023

TARE SHIRT.

Not occupied. A long, flat ridge, partly in cultivation, in Berwick, York Co., Me.; on land owned by George Guptill.

Permanent mark: The tallest tree in a clump of pines.

[Latitude, 43° 19′ 15″·90. Longitude, 70° 49′ 20″·85.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bauneg Beg	203	11	59	23	13	31	3·88296
Agamenticus	315	43	36	135	48	57	4·18023

PROSPECT HILL.

Three miles south of Lancaster Coos Co., N. H., reached by wagon road to summit. An abandoned hotel on top of hill was used as signal. A flag pole on roof over front door was sighted. Instrument was mounted on railing on south edge of roof over front door.

[Latitude, 44° 27′ 05″·88. Longitude, 71° 34′ 16″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Washington (obs'y)	313	14	08·2	133	25	16·6	4·467167
Lafayette	10	19	21·2	190	16	16·2	4·516447

STARR KING.

Triangulation station of the U. S. C. & G. S. in Coos Co., N. H. A bridle path from road near the Wannebec House, Jefferson village, leads to station. Summit clear. Land owned by N. R. Perkins of Jefferson.

Permanent mark: A bolt and triangle.

[Latitude, 44° 26′ 04″·5. Longitude, 71° 25′ 59″·8.]

To station.	Azimuth.			Back Azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Ledge	69	34	02	249	11	16	4·6647814
Lafayette	29	03	44	208	54	52	4·5417566

AGASSIZ.

Reached by wagon road from Bethlehem, Grafton Co., N. H. (2 miles). Theodolite was mounted on roof of first floor of observatory. **Flagstaff** marks center of station.

[Latitude, 44° 15′ 58″·17. Longitude, 71° 40′ 38″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Washington (obs'y)	268	55	40·7	89	11	19·1	4·474540
Lafayette	347	32	26·2	167	33	47·4	4·078725

LAFAYETTE.

Triangulation station of the U. S. C. & G. S. in Grafton Co., N. H. **Reached** from Profile House (4 miles) by a steep trail too rough for horses. Station of U. S. C. & G. S. was probably identified by an iron bolt.

Permanent mark: Rock cairn 10 feet high was erected over center.

[Latitude, 44° 09′ 38″·92. Longitude, 71° 38′ 41″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Washington (obs'y)	245	46	44·0	66	01	00·3	4·4751569
Prospect Hill	190	16	16·2	10	19	21·2	4·516447
Agassiz	167	33	47·4	347	32	26·2	4·078725
Starr King	208	54	52·0	29	03	44·0	4·5417566
Carrigain	295	12	30·2	115	20	45·2	4·24251
Kearsarge, north	277	42	15·5	98	05	14·6	4·6479026

MOUNT WASHINGTON.

Triangulation station of the U. S. C. & G. S. in Coos Co., N. H. **Two** stations were occupied, the first one 102.75 feet southeast of large kitchen chimney or Quimby U. S. C. & G. S. point, to which sights taken to signals east and south were reduced. The second station was the old tripod and observatory over Bache's U. S. C. & G. S. point, from which the western stations were sighted.

Chimney.

[Latitude, 44° 16′ 14″·44. Longitude, 71° 18′ 11″·49.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kearsarge, north.	317	37	35·3	137	46	18·3	4·3937849
Iron	341	27	24·7	161	30	04·2	4·2040230

Observatory.

[Latitude, 44° 16′ 14″·06. Longitude, 71° 18′ 13″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lafayette	66	01	00·3	245	46	44·0	4·4751569
Carrigain	30	20	50·7	210	14	50·3	4·3573200

SOUTH BALDFACE.

On a hill in Coos Co., N. H. Reached from George Chandler's house, North Chatham (4 miles) by well-defined path. Summit cleared, giving a good view.

Permanent mark: Bolt in solid ledge covered with a pile of loose rocks.

[Latitude, 44° 13′ 51″·46. Longitude, 71° 04′ 42″·45.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Washington (chimney)	103	53	13·7	283	43	49·1	4·26682
Kearsarge, north	5	21	26·5	185	20	45·3	4·14492

CARRIGAIN.

Four and a half miles by path from Livermore (Sawyers) Mills, Grafton Co., N. H. Station on eastern of two distinct summits. Some scrub spruce trees still standing.

Permanent mark: Pile of stones.

[Latitude, 44° 05′ 37″·23. Longitude, 71° 26′ 50″·87.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Washington (observatory)	210	14	50·3	30	20	50·7	4·35732
Lafayette	115	20	45·2	296	12	30·2	4·24251

IRON.

Three miles west-southwest of Jackson, Carroll Co., N. H., on highest part of summit near south end.

Permanent mark: Iron bolt in solid ledge.

[Latitude, 44° 08′ 03″·02. Longitude, 71° 14′ 22″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Washington (chimney)	161	30	04·2	341	27	24·7	4·204023
Kearsarge, north	285	07	50·7	105	13	53·8	4·079743
Moat	349	05	24·3	169	06	25·1	4·01234

KEARSARGE NORTH.

A triangulation station of the U. S. C. & G. S., 5 miles by road and trail north northeast of North Conway, Carroll Co., N. H. Station marks left by U. S. C. & G. S. could not be identified. All observations were referred to hole in ledge, said by Mr. Eastman, keeper of the house on top of mountain, to be the place where Prof. Quimby set his theodolite.

[Latitude, 44° 06′ 21″·06. Longitude, 71° 05′ 41″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Washington (chimney)	137	46	18·8	317	37	35·3	4·3937849
Lafayette	98	05	14·6	277	42	15·5	4·6479026
Iron	105	13	53·8	285	07	50·7	4·0797431
South Baldface	185	20	45·3	5	21	26·5	4·14492
Moat	54	16	53·6	234	11	51·7	4·07566

MOAT.

In Carroll Co., N. H., on north summit of mountain, a bare rocky ridge running north and south and about 3 miles long. Station on bare, rocky knob. Ascended from end of highway near Diana's Bath, about 2 miles west of North Conway.

Permanent mark: Iron bolt in solid rock.

[Latitude, 44° 02′ 35″·70. Longitude, 71° 12′ 55″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Iron	169	06	25·1	349	05	24·3	4.01234
Kearsarge, north	234	11	51·7	54	16	53·6	4.07566

WATATIC.

An old Borden station on Watatic Mountain, Worcester Co., Mass. The description of station says that there is a copper bolt, but it could not be found; a hole apparently drilled was found and it is probable that this hole held the bolt. A tree 36 feet distant was used as center and signal in triangulation.

Tree.

[Latitude, 42° 41' 48''·47. Longitude 71° 53' 34''·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	'	''	°	'	''	*Meters.*
Groton Hill	289	05	37	109	19	14	4·46377
Turkey Hill	308	13	30	128	20	52	4·27752
Brown Hill	336	03	12	156	05	09	3·98767
Wachusett (chimney)	358	54	24	178	54	37	4·36285
Ward Hill	58	33	41	238	27	17	4·43117
Dolbar Hill	39	05	42	218	58	58	4·33375
Town Hill	48	59	17	228	53	33	3·99996

Borden station.

[Latitude, 42° 41' 48''·55. Longitude, 71° 53' 34''·37.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	'	''	°	'	''	*Meters.*
Wachusett C. S. station	358	48	56	178	49	10	4·36320

TOWN HILL.

A station situated on Town Hill about 6 miles west of Ashburnham Center and 4 miles north of Gardner, Worcester Co., Mass.

Permanent mark: A tree that stands about 200 or 300 feet northeast of summit of hill.

[Latitude, 42° 38' 15''·54. Longitude, 71° 59' 05''·39.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	'	''	°	'	''	*Meters.*
Watatic	228	53	33	48	59	17	3·99996
Brown Hill	281	20	34	101	26	10	4·06886
Wachusett (chimney)	334	06	35	154	10	32	4·26291
House on hill	359	26	11	179	26	13	3·79814
Dolbar Hill	30	42	47	210	39	50	4·07328

WARD HILL.

A station on Ward Hill in pasture one-half mile south of Templeton and Athol road, at point about 3 miles from Athol, Worcester Co., Mass.

Permanent mark: Large dead tree that stands near summit of hill.

[Latitude, 42° 34' 12''·13. Longitude, 72° 10' 24''·85.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	'	''	°	'	''	*Meters.*
Two tree	194	27	36	14	28	47	3·97883
Watatic	238	27	17	58	33	41	4·43117
Dolbar Hill	285	43	47	105	48	23	3·99224
Wachusett (chimney)	290	48	11	110	50	47	4·40066

DOLBAR HILL.

About half a mile south of Templeton, Worcester Co., Mass., on summit of hill in pasture.

Mark: Stone + U. S. G. S.

[Latitude, 42° 32′ 45″·62. Longitude, 72° 06′ 30″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Town Hill	210	39	50	30	42	47	4·07828
Watatic	218	58	58	39	05	42	4·33375
Wachusett (chimney)	294	07	07	114	14	03	4·18739
Ward Hill	105	48	23	285	43	47	3·96224

BROWN HILL.

This station is on land belonging to Thomas Costello, and is about 4 miles northwest of Fitchburg, Worcester Co., Mass.

[Latitude, 42° 37′ 00″·54. Longitude, 71° 50′ 41″·81.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Turkey Hill	284	34	42	104	40	0·2	4·05316

TURKEY HILL.

About 1 mile east of Lunenburg, Worcester Co., Mass. on land belonging to Mr. John F. Brown.

[Latitude, 42° 35′ 28″·03. Longitude, 71° 42′ 41″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Groton Hill	260	12	26	80	18	36	4·10729
Watatic	128	20	52	308	13	30	4·27752
Wachusett (chimney)	52	00	17	231	53	06	4·26885

GROTON HILL.

On land belonging to Mr. Dodge, about one-half mile west of Groton Center, Middlesex Co., Mass. Station is on top of hill, about 60 feet west from dead tree.

[Latitude, 42° 36′ 38″·28. Longitude, 71° 33′ 28″·31.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Watatic	109	19	14	289	05	37	4·46377
Turkey Hill	80	18	36	260	12	26	4·10729
Wachusett (chimney)	63	38	21	243	24	58	4·48073

WACHUSETT (CHIMNEY).

A U. S. C. & G. S. point in Worcester Co., Mass. This was transferred to chimney of Summit Hotel, which was used as center of station. Mark: Chimney of Summit Hotel.

[Latitude, 42° 29′ 21″·28. Longitude, 71° 53′ 15″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Brown Hill	193	53	44	13	55	28	4·16433
Turkey Hill	231	53	08	52	00	17	4·26385
Groton Hill	243	24	58	63	38	21	4·48073
Boxboro	269	21	38	89	36	13	4·47099
Observatory	286	35	16	106	45	49	4·34969
Reservoir	300	59	52	121	12	47	4·48694
Fay Mountain	322	17	39	142	28	07	4·54359
Ward Hill	110	59	47	290	48	11	4·40066
Dolbar Hill	114	14	03	294	07	07	4·18739
Watatic	178	54	37	358	54	24	4·36285
Town Hill	154	10	32	334	06	35	4·26291

C. & G. S. station.

[Latitude, 42° 29′ 20″·78. Longitude, 71° 53′ 13″·98.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Fay Mountain	322	18	46	142	29	13	4·54328

BOXBORO.

In belfry of town hall at Boxboro, Middlesex Co., Mass. Mark: Center of tower.

[Latitude, 42° 29′ 29″·94. Longitude, 71° 31′ 39″·96.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Reservoir	11	42	13	191	40	39	4·21642
Observatory	50	42	22	230	38	21	4·02316
Wachusett (chimney)	89	36	13	269	21	38	4·47099

OBSERVATORY.

This station is center of observatory in pasture belonging to Mr. Cunningham, and about 4 miles east of Clinton and 1¼ miles west of Bolton, Worcester Co., Mass.

[Latitude, 42° 25′ 53″·23. Longitude, 71° 37′ 37″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boxboro	230	38	21	50	42	22	4·02316
Reservoir	332	51	34	152	53	36	4·02526
Fay Mountain	00	19	59	180	19	50	4·32780
Wachusett (chimney)	106	45	49	286	35	16	4·34969

RESERVOIR.

Center of tower in upper reservoir at Marlboro, Middlesex Co., Mass.

[Latitude, 42° 20′ 47″·50. Longitude, 71° 34′ 05″·96.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boxboro	191	40	39	11	42	13	4·21642
Observatory	152	53	36	332	51	34	4·02526
Fay Mountain	22	45	28	202	43	02	4·10846
Wachusett (chimney)	121	12	47	300	59	52	4·48694

FAY MOUNTAIN.

An old Borden station about 2 miles a little west of south from **Westboro**, Worcester Co., Mass, in pasture, about three-eighths of a **mile** northwest from Mr. James Hannahan's house.

[Latitude, 42° 14′ 23″·79. Longitude, 71° 37′ 42″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters*
Observatory	180	19	50	00	19	59	4·32780
Reservoir	202	43	02	22	45	28	4·10846
Wachusett (chimney)	142	28	07	322	17	39	4·54359

BALD HILL.

Triangulation station of the U. S. C. & G. S. in the southwestern **portion** of the town of Union, Tolland Co., Conn., on the land of Capt. **Burke** Foster.

Permanent mark: Copper bolt in rock on the summit of hill.

[Latitude, 41° 58′ 25″·89. Longitude, 72° 11′ 55″·03.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wachusett (chimney)	204	05	01·00	24	17	34·50	4·7975447
Mount Tom	128	48	17·83	308	30	11·05	4·678180
Green Hill	41	57	56·00	221	50	22·00	4·370084
Soapstone	84	47	38·00	264	39	00·00	4·252975
Box Hill	47	57	32·58	227	47	14·07	4·4593557
Storrs Monument	15	56	41·00	195	54	15·00	4·264726
Post Hill	19	08	11·00	199	02	34·00	4·551575
Robinson Hill	333	33	21·00	153	38	06·00	4·344868

SOAPSTONE.

In southeastern corner of town of Somers, Tolland Co., Conn., 6 **miles** from Stafford Springs. Several acres of timber were cut, giving a **good** view in nearly all directions.

Permanent mark: A large bowlder due south of signal; distance 25 feet.

[Latitude, 41° 57′ 32″·50. Longitude, 72° 24′ 49″·80.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Bald Hill.........	264 39 00	84 47 38	4·252975
Box Hill..........	11 14 26	191 12 45	4·255619
Green Hill........	....	....	4·202901
Peak	90 06 25	269 53 20	4·432218

PEAK.

Station on Copper Hill, 1½ miles north-northwest of East Granby vi lage, Hartford Co., Conn., 4 miles north-northeast of Tariffville, on half mile by path east of old Newgate prison.

Permanent mark: A pine tree near edge of bluff at south extremit of long summit; tree trimmed up.

[Latitude, 41° 57′ 32″·48. Longitude, 72° 44′ 24″·02.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Soapstone	269 53 20	90 06 25	4·432218
Box Hill..........	306 45 01	126 56 24	4·469305

ROBINSON HILL.

A perfectly bald hill in town of Hampton, Windham Co., Conn., 2 miles northwest of the village. Land owned by Ralph W. Robinson, who lives one-fourth of a mile from triangulation station, on southeas side. Station on south side of a stone wall running east and west an crossing the hill at highest point.

Permanent mark: Rocks piled at foot of pole.

[Latitude, 41° 47′ 43″·61. Longitude, 72° 04′ 48″·29.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Box Hill	91 02 29	270 47 27	4·494768
Bald Hill.........	153 38 06	333 33 21	4·344868
Storrs Monument.	....	....	4·177694

STORRS MONUMENT.

Not occupied. On a hill back of Storrs Agricultural College, norther central part of town of Mansfield, Tolland Co., Conn. Hill partly covered with trees and birch brush.

Permanent mark: Granite shaft 25 feet high.

[Latitude, 41° 48′ 52″·51. Longitude, 72° 15′ 33″·96.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Green Hill	91	20	02	271	14	55	4·026446
Bald Hill	195	54	15	15	56	41	4·264726
Robinson Hill	………			………			4·177694

GREEN HILL.

A bald hill in the northwest part of the town of Coventry, Tolland Co., Conn. Station in field owned by Samuel Green, on highest part of ridge. Some timber still stands on northwest edge of field. Samuel Green lives one-third of a mile west and Ambrose Royal lives one-third of a mile southeast of triangulation point.

Permanent mark: A chestnut pole 30 feet high.

[Latitude, 41° 49′ 00″·26. Longitude, 72° 23′ 14″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Box Hill	71	54	38	251	51	53	3·778222
Bald Hill	221	50	22	41	57	56	4·370084
Post Hill	………			………			4·222644
Soapstone	………			………			4·202901
Storrs Monument	271	14	55	91	20	02	4·026446
Sweets Hill	321	03	21	141	09	37	4·317776

BOX HILL.

Triangulation station of the U. S. C. & G. S. in the town of Bolton, Tolland Co., Conn. Station is on the highest point directly in line from Bald Hill to Sandford.

Permanent mark: Drill hole, with a copper bolt in rock.

[Latitude, 41° 47′ 59″·79. Longitude, 72° 27′ 21″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Tom	162	08	16·31	341	55	31·98	4·7127917
Bald Hill	227	47	14·07	47	57	32·58	4·4593557
Ivy Hill	97	23	00·05	276	52	14·77	4·3084201
Green Hill	251	51	53·00	71	54	38·00	3·778222
Peak	126	56	24·00	306	45	01·00	4·469305
Robinson Hill	270	47	27·00	91	02	29·00	4·494768
Soapstone	191	12	45·00	11	14	26·00	4·255619
Post Hill	325	44	53·00	145	49	34·00	4·238931

MEETING HOUSE HILL.

In Franklin township, New London Co., Conn., one-half mile from Franklin depot. Station in field belonging to Mr. Ladd, whose house is 150 yards north-northwest. Summit, flat; view partly cut off by orchard to northward.

Permanent mark: Flag pole, 15 feet high.

[Latitude, 41° 36′ 08″·68. Longitude, 72° 08′ 38″·97.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Post Hill	115	11	06	295	03	20	4·253116
Sweet Hill	136	43	15	316	39	49	4·020371

SWEET HILL.

A partly cleared hill, 3½ miles south-southwest of Willimantic, and in the town of Lebanon, New London Co., Conn. The Willimantic and Lebanon road passes around the hill on the eastern side. Hill owned by Dr. Sweet, Lebanon village. A few oak trees on southeast edge of summit.

Permanent mark: Rocks piled up.

[Latitude, 41° 40′ 15″·88. Longitude, 72° 13′ 49″·55.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Post Hill	89	53	29	269	49	10	3·955375
Green Hill	141	09	37	321	08	21	4·317776
Meeting House Hill	316	39	49	136	43	15	4·020371

POST HILL.

Station on land owned by W. C. Robinson, 8 miles southwest of Willimantic, in town of Columbia, Tolland Co., Conn., near Hebron line. Apple trees interfere with the view to the west; no obstructions in other directions.

Permanent mark: A flag pole, 30 feet high.

[Latitude, 41° 40′ 15″·15. Longitude, 72° 20′ 19″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Box Hill	145	49	34	325	44	53	4·238931
Bald Hill	199	02	34	19	08	11	4·551575
Green Hill							4·222644
Meeting House Hill	295	03	20	115	11	06	4·253116
Sweet Hill	269	49	10	89	53	29	3·955375

GRANBY.

On land owned by A. C. Teeter 2 miles north of North Canton village, and in the southwest corner of Granby township, Hartford Co., Conn. Summit flat and cleared of timber.

Permanent mark: A chestnut tree trimmed up.

[Latitude, 41° 55′ 57″·08. Longitude, 72° 53′ 18″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Johnny Cake	23	57	11	203	52	56	4·337369
Ivy	76	30	33	256	17	06	4·457468

IVY.

Triangulation station of the U. S. C. & G. S. on the summit at the south end of the ridge known as Ivy Hill in North Goshen, and about 2 miles north from Goshen Center village, Litchfield Co., Conn. The farm immediately south of station is owned by Mr. Dana Bently, and his house is about one-quarter of a mile southwest of station.

Permanent mark: Copper bolt inserted in rock. The head of bolt is one inch in diameter with two lines crossing the center at right angles.

[Latitude, 41° 52′ 18″·50. Longitude, 73° 18′ 27″·93.]

To station.	Azimuth.			Back azimuth.			Log. Dist.
	°	′	″	°	′	″	*Meters.*
Sandford	333	14	07·82	153	25	05·06	4·7071882
Granby	256	17	06·00	76	30	33·00	4·457468
Box Hill	276	52	14·77	97	23	00·05	4·8084201
Johnny Cake	304	27	26·00	124	36	37·00	4·364915
Mohawk	47	08	17·00	227	05	23·00	3·915723
Wooster	20	54	59·84	200	44	28·82	4·7915137
West Peak	317′	28	36·00	137	43	47·00	4·671544
Ellsworth	67	57	00·30	247	47	50·30	4·312546

JOHNNY CAKE.

Station on highest part of Johnny Cake or West Mountain, in western central part of Burlington Township, Hartford Co., Conn., on land owned by Frank Recor. Summit entirely cleared. A wagon road crosses the mountain from north to south and passes within 150 yards of triangulation station. John Edwards lives one-fourth of a mile north of triangulation point.

Permanent mark: Hole drilled in solid rock.

[Latitude, 41° 45′ 12″·79. Longitude, 72° 59′ 41″·01.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Good	44	17	05	224	06	30	4·501402
Ivy	124	36	37	304	27	26	4·364915
Mount Tom							4·383078
Granby	203	52	56	23	57	11	4·337369
Talcott							4·256089
West Peak							4·396584

MOUNT TOM.

U. S. C. & G. S. station: Station on highest part of Mount Tom, in Washington Township, Litchfield Co., Conn., on land belonging to Albert Anson. The new road leaves Mount Tom pond to the south a short distance beyond the "Corners." The first road west of the pond gives best ascent to the mountain.

Permanent mark: A hole drilled in ledge, at the extreme southwest end of the summit.

[Latitude, 41° 41′ 36″·43. Longitude, 73° 16′ 25″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tashua	357	39	55·72	177	40	51·49	4·6823488
Wooster	25	17	53·27	205	09	21·10	4·6235632
Mohawk	172	13	51·00	352	12	55·00	4·1563950
West Peak							4·5884380
Johnny Cake							4·3830780

WEST PEAK.

Five miles by road northwest of the city of Meriden, New Haven Co., Conn. Station on the highest part of bare ledge, 27 feet 2 inches northeast of flagstaff hole, near edge of cliff.

Permanent mark: Hole drilled in solid rock.

[Latitude, 41° 33′ 34″·90. Longitude, 72° 50′ 38″·78.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Good	88	08	05	267	51	31	4·540789
Ivy	137	43	47	317	28	36	4·671544
Mount Tom							4·588438
Johnny Cake							4·396534

GOOD.

Triangulation station of the U. S. C. & G. S. situated on the highest part of Good Hill, in town of Woodbury, Litchfield Co., Conn. Land owned by Nathan B. Smith. The station is about one-quarter of a mile from Four Corners, in a pasture.

Permanent mark: A flat glass bottle sunk 3 feet in ground, bottom up. Over it are two layers of inch boards, on which rest a large stub reaching to surface; in center of stub a nail.

[Latitude, 41° 32′ 55″·52. Longitude, 73° 15′ 36″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tashua	358	31	27·66	178	31	51·09	4·5054630
Wooster	41	03	04·58	220	54	00·85	4·4635225
Wing	92	50	42·00	272	40	02·00	4·3495800
West Peak	267	51	31·00	88	08	05·00	4·5407890
Johnny Cake	224	06	30·00	44	17	05·00	4·5014020

BEACONPOLE.

Triangulation station of the U. S. C. & G. S. in Providence Co., R. I. A 20-foot platform was erected and the Coast Survey signal, which was still standing July, 1888, was used.

[Latitude, 41° 59′ 42″·47. Longitude, 71° 27′ 01″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Memford	19	08	03·19	199	03	53·14	4·4218726
Tourtellot	56	38	32·09	236	30	20·63	4·3072428
Spencer (2)	6	17	11·20	186	15	19·12	4·5501578
Woonsocket	77	33	33·10	257	29	23·12	3·9451619

WOONSOCKET.

Station on Woonsocket Hill, Providence Co., R. I.

Permanent mark: Copper wire in hole drilled in a large rock 12 feet square.

[Latitude, 41° 58′ 40″·81. Longitude, 71° 33′ 15″·16.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tourtellot	41	56	38·02	221	52	36·62	4·0954877
Beaconpole	257	29	23·12	77	33	33·10	3·9451619

TOURTELLOT.

Station on Tourtellot Hill in town of Glocester, Providence, Co., R. I., about 2 miles southeast from Chepachet.

Permanent mark: Spruce tree denuded of limbs, one side (40-foot observing platform).

[Latitude, 41° 53′ 40″·34. Longitude, 71° 39′ 16″·43.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Memford	328	52	31·54	148	56	32·11	4·2071185
Aldrich	371	44	43·62	191	44	07·23	3·7914820
Beaconpole	236	30	20·63	56	38	32·09	4·3072428
Woonsocket	221	52	36·62	41	56	38·02	4·0954877

ALDRICH.

Station on north end of Chopmist Hill, in town of Scituate, Providence Co., R. I. A 50-foot observing platform was erected.

Permanent mark: A chestnut tree.

[Latitude, 41° 50′ 23″·92. Longitude, 71° 40′ 11″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Weaver	358	36	21·73	178	36	35·77	4·3000474
Memford	308	52	48·54	128	57	25·32	4·0305367
Tourtellot	191	44	07·23	371	44	43. 62	3·7914820

MEMFORD.

An old barn belonging to Mrs. Isaac Memford, in town of Cranston, Providence Co., R. I., and about 10 miles west of the city of Providence.

Permanent mark: A piece of brass set into stone foundation of barn 5 feet 3 inches from top of foundation.

[Latitude, 41° 46′ 13″·10. Longitude, 71° 33′ 15″·83.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spencer (2)	335	07	48·35	155	10	05·71	4·0552672
Weaver	36	45	54·42	216	41	32·19	4·1828648
Beaconpole	199	03	53·14	19	08	03·19	4·4218726
Anthony Mill	355	29	05·38	175	29	24·01	3·9150112
Aldrich	128	57	25·32	308	52	48.54	4·0305367
Tourtellot	148	56	32·11	328	52	31·54	4·207185

ANTHONY MILL.

Point was not occupied in 1888. In town of Coventry, Kent Co., R. I., village of Anthony. Point sighted was cupola of new mill in Anthony.

[Latitude, 41° 41′ 47″·30. Longitude, 71° 32′ 47″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Memford	175	29	24·01	355	29	05·38	3·9150112
Spencer (2)	297	02	99·97	117	04	08·68	3·6660774

SPENCER (2).

This station is in Mr. Benjamin F. Dawley's pasture, town of Warwick, Kent Co., R. I., just south of his house. A 24-foot platform was erected. Station is 790 feet south 55° 46′ west from U. S. Coast and Geodetic Survey station Spencer and 10 feet west of cross mark cut on rock.

Permanent mark: Cross mark cut on rock.

[Latitude, 41° 40′ 38″·87. Longitude, 71° 29′ 49″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spencer (C.& G.S.)	…………			55	46	30·00	2·3816598
Beaconpole	186	15	19·12	6	17	11·20	4·5501578
Anthony Mill	117	04	08·68	297	02	09.97	3·6660774
Franklin	31	55	51·02	211	53	06·92	4·0340647
Memford	155	10	05·71	335	07	48·35	4·0552672
Weaver	82	14	33·84	262	07	54·58	4·1468498

WEAVER.

On Weaver Hill, Coventry Township, Kent Co., R. I., a 50-foot observing platform was erected.

Permanent mark: Spruce tree from which nearly all of the limbs were cut and which formed one side of triangular observing platform.

[Latitude, 41° 39′ 37″·21. Longitude, 71° 39′ 49″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spencer (2)	262	07	54·48	82	14	33·84	4·1468496
Franklin	311	36	34.71	131	40	29·54	4·0394200
Aldrich............	178	36	35·77	358	36	21·73	4·3000474
Memford	216	41	32·19	36	45	54·42	4·1828648

FRANKLIN.

Near Franklin Corner, in the town of Exeter, Washington Co., R. I., a 60-foot observing platform was erected.

Permanent mark: Oak tree (part of platform).

[Latitude, 41° 35′ 41″·35. Longitude, 71° 33′ 56″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spencer (2)	211	58	06·92	31	55	51·02	4·0840647
Sherman...........	337	20	31·00	157	22	30·46	4·0351512
Weaver............	131	40	29·54	311	36	34·71	4·0394200

DAWLEY.

On rocky point northwest of highest point of what is known as the mountain road, in town of Richmond, Washington Co., R. I., a 50-foot observing platform was erected.

Permanent mark: Cross and U. S. G. S. cut in solid rock.

[Latitude, 41° 32′ 12″·06. Longitude, 71° 33′ 02″·68.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sherman....................	287	25	44·38	107	31	06·89	4·0728640
Kingston Church Steeple.	300	59	33·79	121	04	31·44	4·0847784
Champlin...................	63	19	28·22	243	14	19·37	4·0819936

SHERMAN.

Triangulation station of the U. S. C. & G. S. in Washington Co., R. I. A 24-foot observing platform and tripod was erected at a point 2° 10′ north of west from U. S. Coast and Geodetic Survey station Sherman, and 13 feet distant.

Permanent mark: Same as made by U. S. C. & G. S.

[Latitude, 41° 30′ 16″·94. Longitude, 71° 30′ 56″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spencer (2)	184	36	35·54	4	37	19·94	4·2844114
Pine Hill	131	20	35·94	311	16	07·86	4·0959827
Franklin	157	22	30·46	337	20	31·00	4·0351512
Dawley............	107	31	06·89	287	25	44·38	4·0728640

CHAMPLIN.

Station is about 1¾ miles due north of Hopkinton, Washington Co. R. I. A 24-foot observing platform and tripod was erected at a point 10° 14′ south of east from Coast Survey station, Champlin Hill, distant 11 feet 3 inches; the latter is marked by iron spikes in two rocks.

[Latitude, 41° 29′ 16″·04. Longitude, 71° 46′ 47″.91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dawley............	243	14	19·37	63	19	28·22	4·0819936

NEW YORK AND PENNSYLVANIA.

METHODS OF WORK.

NEW YORK.

A comparatively small amount of triangulation has as yet been necessary in addition to that of other organizations. The State is about half covered by triangulation, including the work of the U. S. Lake Survey, along the Great Lakes and St. Lawrence River; that of the U. S. Coast and Geodetic Survey along the Hudson River, Lake Champlain, and the Mohawk Valley; and that of the New York State survey in the central and southern portions of the State. The work in certain areas was supplemented by the U. S. Geological Survey during 1892 and 1893. In June, 1892, a small belt was extended northeastward through Washington County, starting from stations Greenwich, Rafinesque, of the U. S. Coast and Geodetic Survey. Nine stations, controlling four atlas sheets, were occupied. Stations were located on bare hills, though they were not always the highest in the locality, to avoid erection of expensive scaffolds, or heavy damages for destruction of timber.

Later in the season of 1892 a system of quadrilaterals was started across the Catskill region from Powell-Merino, stations of the U. S. Coast and Geodetic Survey in the Hudson Valley near Coxsackie. Seven stations, controlling three atlas sheets, were located. Old observatories were found on many of the wooded mountain summits and were sighted as signals and occupied with the theodolite.

During 1893 work was extended across Clinton County from the line Lyon-Dannemora, of the U. S. Coast and Geodetic Survey. The northern border of the State is very difficult to triangulate, there being no well-defined points after leaving the high rocky peaks of the Adirondack region, the ridges being flat and heavily wooded. Eight stations within three atlas sheets were located.

The work in Oswego and Jefferson counties was based upon stations of the U. S. Lake Survey, Sandy Creek-Mannsville being used as a base in Oswego County and Cooper-Gleason in Jefferson County. Eighteen stations were occupied in this portion of the State, furnishing control for five atlas sheets.

A few stations in addition to those of the U. S. Lake Survey were located in Chautauqua and Erie counties. The line Silver Creek-Dunkirk light-house was used as a base from which the positions of five stations were determined.

In October, 1893, four stations were located in Ulster County, southwest of Kingston; these were based upon Terry, Prospect, and Lloyd, stations of the U. S. Coast and Geodetic Survey on the banks of the Hudson near Rondout.

All of the work of the U. S. Geological Survey in New York has been done by S. S. Gannett, assisted by B. C. Washington, jr. A Fauth 8-inch theodolite has been used, angles having been read, in most cases, by the method of directions. No least square figure adjustment has been made.

PENNSYLVANIA.

Triangulation of the U. S. Coast and Geodetic Survey in the anthracite coal region was supplemented during the years 1889, 1890, and 1891. Twenty-five points were located, furnishing control for fifteen atlas sheets.

The location of stations on flat, wooded, mountain summits in many cases necessitated the elevation of the theodolite from 10 to 50 feet above the ground, an interior tripod for the support of the instrument being built with an exterior structure for the observer.

In August, 1892, a few stations were added to those already located in the vicinity of Reading and Allentown. Angles were measured with a Fauth 8-inch theodolite. No figure adjustment has been made.

DESCRIPTIONS AND POSITIONS OF STATIONS.

DEERING.

Station located on north end of high ridge, in town of Arkwright, Chautauqua Co., N. Y., about one-eighth of a mile south of Sheridan line, 175 yards west of main north and south road. Louis Deering owner of property.

Permanent mark: Copper bolt in bowlder.

[Latitude, 42° 25′ 49″·50. Longitude, 79° 14′ 19″·03.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dunkirk, L. H	126	32	17·5	306	27	36·1	4·07358
Brooks (chimney)	130	51	26·9	310	47	59·1	3·96816
Pierce	265	43	43·8	85	47	06·4	3·83766
Dean	209	02	04·8	29	05	39·7	4·15428
Silver Creek	186	44	32·3	6	45	07·2	4·00268

SHEFLIN.

Two miles south southeast of Angola Depot, in town of Evans, Erie Co., N. Y., about 75 yards north of Brant line or road: One-fourth of a mile east of north and south road. Station in pasture on highest ground owned by Jacob Sheflin.

Permanent mark: Stone monument 4 feet long, copper bolt stamped U. S. G. S., 459, N. Y.

[Latitude, 42° 36′ 38″·41. Longitude, 79° 00′ 30″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pierce	31	45	15 2	211	39	18·2	4·36053
Dean	57	47	53·1	237	41	58·0	4·15089
Richmond	283	07	13·0	103	12	33·2	4·04439

RICHMOND.

Not occupied, situated in Erie Co., N. Y. Station on land owned by Nathaniel Richmond, in North Collins, 1½ miles west of Langford, just north of main east and west road; just north of and 75 yards distant from house of Charles Cook, 10 feet northeast of old well.

Permanent mark: Stone monument, copper bolt No. 458, U. S. G. S., N. Y.

[Latitude, 42° 35′ 16″·65. Longitude, 78° 52′ 37″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pierce	53	28	02·2	233	16	45·7	4·45452
Sheflin	103	12	33·2	383	07	13·0	4·04439

DEAN.

One mile east of Silver Creek depot, Chautauqua Co., N. Y., just outside of corporation limits, on highest ground in immediate vicinity. Station about 150 feet north of main east and west road on line running east and west, separating property of George Dean and Dr. Evarts.

Permanent mark: Stone monument, copper bolt stamped U. S. G. S., 460, N. Y.

[Latitude, 43° 32′ 33·61″. Longitude, 79° 09′ 15·62″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pierce	0	21	05·2	180	21	03·0	4·07774
Deering	29	05	29·7	209	02	04·8	4·15428
Sheflin	237	41	58·0	57	47	53·1	4·15089

SILVER CREEK.

Triangulation point of the U. S. Lake Survey in Sheridan Township, Chautauqua Co, N. Y., 3 miles west of village of Silver Creek, three-quarters of a mile east of Sheridan railroad station. A new railroad has cut through primary station, destroying center mark. A new station was established about 75 feet south of railroad track in open field.

Permanent mark: Stone monument marked U. S. Reference stone monument north 58° 08′ east, 283.9 feet.

[Latitude, 42° 31′ 13″·34. Longitude, 79° 13′ 27″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Deering	6	45	07·2	186	44	32·3	4·00268
Brooks (chimney)	64	31	29·4	244	27	26·9	4·95879
Dunkirk, L. H	74	38	49·2	254	33	33·0	4·045157
Pierce	329	04	40·7	149	07	28·5	4·04343

PIERCE.

Station on a knoll in cultivated field, in town of Villenova, Chautauqua Co., N. Y., about 50 yards south of Hanover line, close by main road to Forestville. L. J. Pierce, owner. L. W. Geer lives on place.

Permanent mark: Cut marble post 8 by 8 by 30 inches flush with ground. Copper bolt stamped U. S. G. S., 457, N. Y.

[Latitude, 42° 26′ 06″·00. Longitude, 79° 09′ 18″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Deering	85	47	06·4	275	48	43·8	3·83766
Silver Creek	149	07	28·5	329	04	40·7	4·04343
Richmond	233	16	45·7	53	28	02·2	4·45452
Sheflin	211	39	18·2	31	45	15·2	4·36053
Dean	180	21	03·0	0	21	05·2	4·07774

DUNKIRK, LIGHT-HOUSE.

Triangulation point of the U. S. Lake Survey, situated 1¼ miles northwest of city of Dunkirk, Chautauqua Co., N. Y. Instrument on iron platform about 35 feet above ground.

Permanent mark: Center of brick tower.

[Latitude, 42° 29′ 37″·80. Longitude, 79° 21′ 15″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Silver Creek	254	33	33·0	74	38	49·2	4·045157
Deering	306	27	36·1	126	32	17·5	4·07358

COOPER.

Triangulation point of the U. S. Lake Survey. Station one-quarter of a mile from end of Peninsula Point, Jefferson Co., N. Y., and nearly west of Sacketts Harbor in cultivated field.

Permanent mark: Hole drilled in stone post 1 foot below surface.

Reference post, south 68° west 36·0 meters.

Reference post, north 73° east 52·0 meters.

Reference post, north 24° east 62·5 meters.

[Latitude, 43° 57′ 48″·2. Longitude, 76° 16′ 41″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Horse Island	281	57	39·4	102	03	11·5	4·037713
Hovey	338	51	49·1	158	53	34·2	3·972121
Greene	287	34	30·3	107	58	46·9	4·591839

GLEASON.

Triangulation point of the U. S. Lake Survey. Station 4 miles northeast of Stony Point light-house, about 1⅝ miles southwest of the west end of Snowshoe Bay, Jefferson Co., N. Y.

Permanent mark: Triangular hole drilled in bed rock 1 foot below surface. A surface stone is planted directly over it.

[Latitude, 43° 52′ 48″·9. Longitude, 76° 15′ 32″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Horse Island	232	38	31·0	52	43	15·0	4·060565

HOVEY.

In town of Henderson, Jefferson Co., N. Y., on flat bluff on west side of Henderson Bay, in cleared pasture, with fringe of timber around edge of bluff. Land owned by Mr. Hovey, who lives half a mile northeast of station. The mark is a hole drilled in solid rock 1 foot below surface. Surface mark, a bowlder set over center with a cross cut a half-inch deep on its top.

[Latitude, 43° 53′ 04″·77. Longitude, 76° 14′ 09″·99.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Johnson	256	04	34·99	76	20	57·66	4·512470
Horse Island	228	21	33·99	48	25	20·75	3·989328
Cooper	158	53	34·19	338	51	49·10	3·972121
Greene	275	10	40·49	95	28	11·39	4·531514
Carl	274	03	13·99	94	22	06·34	4·563231

CARL.

A round bare hill three-fourths of a mile northeast of Cronk Corners, Lewis Co., N. Y., owned by Thomas Carl.

Permanent mark: Stone monument, copper bolt stamped U. S. G. S., 449, N. Y. Stones piled around monument.

[Latitude, 43° 51′ 37″·67. Longitude, 75° 46′ 56″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Greene	79	54	50·30	259	53	28·80	3·426238
Johnson	155	07	25·60	335	04	55·00	4·061204
Boynton	109	35	50·80	289	29	46·90	4·094678
Hovey	94	22	06·34	274	03	13·99	4·563231

GREENE.

A cleared ridge in town of Pinckney, Lewis Co., N. Y., in lot 30, Franklin Greene owner, 2½ miles east-southeast of Whitesville.

Permanent mark: Stone monument, in which is a copper bolt stamped U. S. G. S., 448, N. Y.

[Latitude, 43° 51′ 22″·53. Longitude, 75° 48′ 53″·76.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cooper	107	53	46·90	287	34	30·30	4·591839
Johnson	168	29	45·60	348	28	36·50	4·046701
Carl	259	53	28·80	79	54	50·30	3·426238
Hovey	95	28	11·39	275	10	40·49	4·531514

BOYNTON.

Station on cleared ridge, 5 miles south of Watertown, Jefferson Co., N. Y., owned by Lester Boynton. Highest land within 6 or 8 miles.

Permanent mark: Stone monument 4 feet long; in which is a copper bolt stamped U. S. G. S., 450, N. Y.

[Latitude, 43° 58′ 52″·46. Longitude, 75° 55′ 41″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Carl	289	29	46·9	109	35	50·8	4·094678
Buckminster	160	34	41·1	340	32	05·0	4·177686
Horse Island	106	05	15·3	285	56	12·8	4·258931
Johnson	227	29	42·6	47	33	16·1	3·968754

LOOMIS.

Triangulation point of the U. S. C. & G. S. Station is situated near the village of Palermo, Oswego Co., N. Y., about four-fifths of a mile south-southwest from "Jennings Corner" or "Palermo Center," on land owned by Mr. J. W. K. Loomis.

Permanent mark: An apothecary's short-neck bottle filled with ashes 30 inches below surface; a marble post 30 inches long rests on the bottle with letters U. S. C. S. upon its top. Four other posts are set with centers, each 5 feet north, south, east, and west (true) from the station.

[Latitude, 43° 21′ 18″·46. Longitude, 76° 17′ 10″·37.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Florence	265	44	53·68	86	10	41·57	4·7064895
Fenner	314	53	10·34	135	15	27·12	4·7960549

JOHNSON.

A bare summit on edge of table-land, 4 miles southeast of Watertown, Jefferson Co., N. Y.

Permanent mark: Copper bolt in solid rock, stamped U. S. G. S., 451 N. Y.

[Latitude, 43° 57′ 16″·05. Longitude, 75° 50′ 33″·36.]

To station.	Azimuth.			Back asimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Carl	335	04	55·00	155	07	25·60	4·061204
Greene	348	28	36·50	168	29	45·60	4·046701
Boynton	47	33	16·10	227	29	42·60	3·968754
Seeber	140	59	02·60	320	51	50·60	4·341508
Miller	192	18	14·20	12	21	50·70	4·510670
Pamelia	169	50	50·70	349	49	26·30	4·185362
Buckminster	123	44	54·60	303	38	44·70	4·154169
Horse Island	87	05	51·00	266	53	14·70	4·386219
Hovey	76	20	57·66	256	04	34·99	4·512470

HORSE ISLAND.

Light-house on Horse Island, Sacketts Harbor, Jefferson Co., N. Y., one-half mile from village. Instrument on iron platform about 80 feet above ground, outside of lenses.

Permanent mark: Center of brick tower.

[Latitude, 43° 56′ 34″·70. Longitude, 76° 08′ 43″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Johnson	266	53	14·7	87	05	51·0	4·386219
Boynton	285	56	12·8	106	05	15·3	4·258931
Hovey	48	25	22·8	228	21	36·0	3·989328
Buckminster	233	26	50·1	53	33	17·1	4·188920
Cooper	102	03	11·5	281	57	39·4	4·037713
Gleason	52	43	15·0	232	38	31·0	4·060565

BUCKMINSTER.

Two miles north of Brownville, Jefferson Co., N. Y., on highest land within several miles.

Permanent mark: Stone monument 3 feet long set in shale rock 2 feet east of stone fence.

[Latitude, 44° 01′ 32″·44. Longitude, 75° 59′ 25″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Johnson	303	38	44·7	123	44	54·6	4·154169
Boynton	340	32	05·0	160	34	41·1	4·177686
Horse Island	53	33	17·1	233	26	50·1	4·188920
Seeber	167	46	24·7	347	45	22·9	3·970462

PAMELIA.

Station in field north of road leading west from Pamelia Four Corners, Jefferson Co., N. Y., about one-third of a mile from the Corners on land belonging to David Countryman.

Permanent mark: Copper bolt in bowlder.

Station to hickory tree (blazed) northeast, 55·8 feet.

Station to hickory tree (blazed) east, 27·8 feet.

Station to arrowhead in bowlder northwest, 12·0 feet.

Station to arrowhead in bowlder west, 8·0 feet.

[Latitude, 44° 05′ 24″·76. Longitude, 76° 52′ 34″·78.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Miller	210	03	54·8	30	08	56·2	4·282475
Johnson	349	49	26·3	169	50	50·7	4·185362
Seeber	100	02	30·5	279	56	42·5	4·052824

SEEBER.

In Clayton Township, 2½ miles west of Stone Mills, 3 miles north of Perch River, Jefferson Co., N. Y., 400 yards north of house of Walter Seeber, just inside of fence on east side of road and on edge of grain field.

Permanent mark: Stone monument, copper bolt, distance to small tree near rail fence to northward, 264 feet.

[Latitude, 44° 06′ 28″·26. Longitude, 76° 00′ 54″·81.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pamelia	279	56	42·5	100	02	30·5	4·052824
Johnson	320	51	50·6	140	59	02·6	4·341508
Buckminster	347	45	22·9	167	46	24·7	3·970462

MILLER.

Three miles northeast of Theresa village, Jefferson Co., N. Y., on highest land within many miles.

Permanent mark: Copper bolt in bowlder.

[Latitude, 44° 14′ 21″·87. Longitude, 75° 45′ 22″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Johnson	12	21	50·7	192	18	14·2	4·510670
Pamelia	30	08	56·2	210	08	54·8	4·282475

COLWELL.

In Ellisburg, Jefferson Co., N. Y., 4 miles southwest of Ellisburg village, three-fourths mile east of Lake Ontario, on land owned by Hamilton Colwell, jr., 150 yards west of his residence.

Permanent mark: Cut marble post 8 by 8 by 30 inches set flush with surface. Copper bolt No. 437.

[Latitude, 43° 41′ 40″·56. Longitude, 76° 11′ 10″·78.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lowrey...........	269	08	15·4	89	16	01·5	4·179366
Sandy Creek......	304	57	38·7	125	01	07·4	3·917406
Dyke.............	13	13	00·3	193	10	46·5	4·279942
Thomas...........	308	20	09·4	128	28	37·7	4·323686

MANNSVILLE.

Triangulation point of the U. S. Lake Survey, situated in Mannsville, Jefferson Co., N. Y., one-half mile northeast of the village of Mannsville; in lot 177, Ellisburg Township, on highest ground in the vicinity.

Permanent mark: Marble post 1½ feet below surface. Reference posts—one north 67° 48′ east, distant 91·79 meters; one south 54° 30′ east, distant 107·84 meters; one south 34° 06′ west, distant 393·1 meters.

[Latitude, 43° 12′ 54″·41. Longitude, 76° 03′ 14″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sandy Creek.......	29	01	23·36	208	59	23·34	3·904569
Oswego............	51	05	31·07	230	46	29·63	4·679876
South Base	52	25	20·85	232	19	23·89	4·164962
North Base	71	10	47·73	251	04	43·36	4·096264
Stony Point	127	29	58·81	307	20	08·21	4·380805
Colwell...........	77	58	48·70	257	53	19·70	4·037532
Lowrey............	294	55	22·20	114	57	39·50	3·690725

LOWREY.

In Oswego Co., N. Y., one-half mile south of Jefferson Co. line, 4 miles from Mannsville, 6 miles from Sandy Creek, in field of James E. Lowrey, one-third of a mile south of his house.

Permanent mark: Dressed stone with copper bolt in center of top, No. 439.

[Latitude, 43° 41′ 47″·37. Longitude, 75° 59′ 55″·94.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mannsville	114	57	39·5	294	55	22·2	3·690725
Colwell	89	16	01·5	269	08	15·4	4·179366
Sandy Creek	59	20	57·2	239	16	40·0	3·986883
Dyke	46	10	02·4	226	00	03·6	4·432104

SANDY CREEK.

Triangulation point of the U. S. Lake Survey. Station in Sandy Creek Township, Oswego Co., N. Y., 1 mile northwest of village of Sandy Creek. Land owned by Jacob Hadley, who lives 300 feet east of station.

Permanent mark: Dressed stone 1 foot below surface.

[Latitude, 43° 39′ 06″·93. Longitude, 76° 06′ 08″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lowrey	239	16	40·00	59	20	57·20	3·986883
Colwell	125	01	07·40	304	57	38·70	3·917406
Mannsville	208	59	23·34	29	01	23·36	3·904569

THOMAS.

Station on cleared hill three-fourths of a mile east of Orwell village, Oswego Co., N. Y., 300 yards south of main east and west road, in a cultivated field belonging to George Thomas, hotel-keeper at Orwell.

Permanent mark: Dressed stone set 8 inches below surface. White ash tree north 13° 34′ west 117·3 feet; dressed stone north 83° 48′ east 241·8 feet.

[Latitude, 43° 34′ 36″·42. Longitude, 75° 58′ 54″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dyke	75	26	38·1	255	15	56·9	4·334257
Colwell	128	28	37·7	308	20	09·4	4·323686

DYKE.

In town of Mexico, Oswego Co., N. Y., 4 miles from the village, in a cleared field on shores of Mexico Bay, 100 yards from water's edge, and about 100 yards from Richland town line. Denny Dyke owner of land.

Permanent mark: Stone set 2 feet in ground; projects 6 inches; copper bolt in stone, No. 436.

[Latitude, 43° 31′ 39″·54. Longitude, 76° 14′ 24″·76.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Colwell	193	10	46·5	13	13	00·3	4·279942
Lowrey	226	00	03·6	46	10	02·4	4·432104
Thomas	255	15	56·9	75	26	38·1	4·384257

MOORE.

Seven miles northwest of Ellenburg Depot, Clinton Co., N. Y., 1 mile east of Clinton Mills, in field of James Moore, one-fourth of a mile north of his house. Summit of hill flat.

Permanent mark: A copper bolt, 4 inches long and 1 inch in diameter, sunk in solid rock; top of bolt stamped U. S. G. S., 431, N. Y.

[Latitude, 44° 57′ 53″·71. Longitude, 73° 51′ 36″·52.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haseltine	20	31	03·6	200	27	59·8	4·212828
Churubusco	78	18	11·1	258	15	08·9	3·762444
West Hill	36	43	00·5	216	38	07·9	4·182583
Dannemora	335	16	43·9	152	22	49·9	4·436154
Lyon	0	31	50·1	180	31	50·5	4·461256

CHURUBUSCO.

Station in center of tower of St. Philominus Catholic Church, Churubusco, Clinton Co., N. Y. Tower is solid masonry. Instrument in belfry about 55 feet above ground.

Permanent mark: A copper bolt let into a timber of floor of belfry, stamped U. S. G. S., 434, N. Y.

[Latitude, 44° 57′ 15″·63. Longitude, 73° 55′ 15″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haseltine	0	10	13·2	180	10	11·9	4·149718
West Hill	17	14	52·7	197	13	02·6	4·062777
Moore	258	15	08·9	78	18	11·1	3·762444
Lyon	348	56	32·3	168	59	25·9	4·451317

WEST HILL.

Not occupied. In Ellenburg township, 3½ miles west of Ellenburg Center, Clinton Co., N. Y. Station on highest part of flat wooded summit, on land owned by Peter Kent, near a pile of loose rock 4 feet high, 15 feet in diameter.

Permanent mark: Stone monument of usual form. U. S. G. S., 433, N. Y.

[Latitude, 44° 51′ 18″·11. Longitude, 73° 58′ 31″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Moore	216	38	07·9	36	43	00·5	4·182583
Haseltine	312	16	33·6	132	18	22·4	3·660504
Churubusco	197	13	02·6	17	14	52·7	4·062777

HASELTINE.

In Clinton Co., N. Y., 3½ miles southwest of Ellenburg Center, on land owned by heirs of Jon. W. Haseltine, one-half mile south of house of Adin Haseltine. Summit is rounded and clear of timber.

Permanent mark: Stone monument 4 feet long, 6 inches square at top; copper bolt in top stamped U. S. G. S., 432, N. Y.

[Latitude, 44° 49′ 38″·34. Longitude, 73° 55′ 56″·95.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Upton	237	35	34·6	57	52	30·7	4·572074
Lyon	338	09	06·9	158	12	01·6	4·166817
Moore	200	27	59·8	20	31	03·6	4·212828
Churubusco	180	10	11·9	0	10	13·2	4·149718
West Hill	132	18	22·4	312	16	33·6	3·660504
Covey	208	04	53·1	28	10	50·9	4·372419

DANNEMORA.

Triangulation point of the U. S. C. & G. S. Station on eastern summit of Dannemora Mountain, Clinton Co., N. Y., 1½ miles northeast of village of Dannemora. The broad summit was cleared of timber except to the northwest. Theodolite was elevated on tripod 22 feet high.

Permanent mark: An iron bolt in solid rock 1 foot below surface of ground.

[Latitude, 44° 44′ 30″·04. Longitude, 73° 42′ 57″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Moore	155	22	49·9	335	16	43·9	4·436154
Covey	168	51	38·1	348	48	25·8	4·489897
Upton	206	07	47·9	26	15	33·6	4·516202
Lyon	70	39	32·1	250	33	18·3	4·093158

UPTON.

Two miles west northwest of Perry Mills, Clinton Co., N. Y., one-half mile north of schoolhouse, where north and south road crosses international boundary line between New York and Canada.

Permanent mark: Iron boundary post projecting 3½ feet above ground.

[Latitude, 45° 00′ 24″·10. Longitude, 73° 31′ 57″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lyon	38	02	33·5	217	48	33·4	4·628909
Covey	92	30	06·6	272	19	06·8	4·310466
Haseltine	57	52	30·7	237	35	34·6	4·572074
Dannemora	26	15	33·6	206	07	47·9	4·516202

COVEY.

Not occupied. One mile north of international boundary line between New York and Canada, 2 miles west of Covey Hill. Station on southeast end of ridge, 200 feet lower than summit, 300 yards south of main east and west road, in field 500 feet southeast of house of John Waddell.

Permanent mark: A pole in center of a pile of rocks 5 feet high and 30 feet in diameter.

[Latitude, 45° 00′ 51″·89. Longitude, 73° 47′ 30″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lyon	9	23	27·7	189	20	25·2	4·542663
Haseltine	28	10	50·9	208	04	53·1	4·372419
Upton	272	19	06·8	92	30	06·6	4·310466
Dannemora	348	48	25·8	168	51	38·1	4·489897

LYON.

Triangulation station, Mount Lyon (2), of the U. S. C. & G. S. Station on northeast rocky bluff of summit. The broad wooded summit cuts off the view to the southwest. The top was reached by trail from Lyon Mountain station, Clinton Co., N. Y., a distance of 3½ or 4 miles.

Permanent mark: A copper bolt in solid rock, marked V. C., Adirondack Survey, 1876.

[Latitude, 44° 42′ 16″·74. Longitude, 73° 51′ 43″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haseltine	158	12	01·6	338	09	06·9	4·166817
Churubusco	168	59	25·9	348	56	32·3	4·451317
Moore	180	31	50·5	0	31	59·1	4·461256
Dannemora	250	33	18·3	70	39	32·1	4·093158
Upton	217	48	33·4	38	02	33·5	4·628909
Covey	189	20	25·2	9	23	27·7	4·542663

BIRCH.

In northwest corner of town of Hebron, Washington Co., N. Y., 8 miles southwest of Granville, 1 mile northwest of North Hebron. Station on land owned by John Brown, living on west side of hill. Summit flat, but cleared of timber.

[Latitude, 43° 20′ 18″·94. Longitude, 73° 20′ 11″·01.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rupert	287	06	54·5	107	12	31·1	4·063265
Rascal	32	37	24·3	212	34	36·5	4·010145

RASCAL.

In western part of town of Hebron, Washington Co., N. Y., very close to Argyle line, a cleared summit of ridge, giving a good view in all directions except northwest. Land owned by James A. McNeil, who lives on west side. Station 10 miles from Salem, 4 miles northwest of West Hebron.

[Latitude, 43° 15′ 39″·49. Longitude, 73° 24′ 15″·68.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rupert	252	28	52·8	72	37	16·9	4·239952
Jackson	358	56	28·7	178	56	40·0	4·307820
Birch	212	34	36·5	32	37	24·3	4·010145

GREENWICH.

Triangulation station of the U. S. C. & G. S. Station 4½ miles north of village of Greenwich, Washington Co., N. Y. Local name is Bald Mountain. Owner is Dennis Sullivan, who lives north of triangulation point. Summit wooded on east and west sides. A comparatively low hill and not a good station.

Permanent mark: Iron bolt in solid rock.

[Latitude, 43° 07′ 35″·12. Longitude, 73° 31′ 30″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Adams	315	06	51·1	135	14	05·0	4·303497
Tilton							4·108687
Jackson	297	40	19·6	117	45	28·1	4·061951
Rafinesque	11	15	46·8	191	12	08·2	4·581978
Rupert	232	32	11·5	52	45	32·8	4·521466

JACKSON.

In central part of town of Jackson, Washington Co., N. Y., 4 miles northwest of Cambridge, from which place it is best reached, 7 miles east of the village of Greenwich. Station on highest cleared summit of ridge, on land owned by Robert Allen, who lives one-fourth of a mile southeast.

[Latitude, 43° 04′ 41″·28. Longitude, 73° 23′ 59″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tilton	40	32	45·9	220	29	54·4	3·942186
Greenwich	117	45	28·1	297	40	19·6	4·061951
Rascal	178	56	40·0	358	56	28·7	4·307820
Rupert	212	22	47·2	32	30	59·1	4·480633

TILTON.

Seven miles south of Greenwich, Washington Co., N. Y., 1 mile east of Summit railroad station. Mr. Thomas, owner, lives on north side. Leonard Tingue lives on south side. Top is entirely cleared of timber.

[Latitude, 43° 01′ 05″·64. Longitude, 73° 28′ 10″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Adams	283	03	51·0	103	08	41·8	3·996239
Rafinesque	25	16	47·3	205	10	47·6	4·449087
Greenwich							4·108687
Jackson	220	29	54·4	40	32	45·9	3·942186

RUPERT.

A bald summit, 4 miles north of Rupert village, Rutland Co., Vt., and 3½ miles south of Pawlet; 10 miles southeast of Granville, via Pawlet; road from Pawlet to Rupert passes just east of station. Land owned by James Jennings, who lives one-third of a mile south of station.

Signal: A small tree with tuft of brush at top and white flag below.

[Latitude, 43° 18′ 28″·33. Longitude, 73° 12′ 00″·46.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Jackson	32	30	59·1	212	22	47·2	4·480633
Greenwich	52	45	32·8	232	32	11·5	4·521466

ADAMS.

In town of White Creek, Washington Co., N. Y.; local name, Mount Tom. James Adams, owner. Sullivan Center lies one-half mile northeast of station, which is in a cleared field on highest part of summit Some timber on south end of hill. Best reached from Cambridge.

[Latitude, 42° 59′ 52″·82. Longitude, 73° 21′ 04″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rafinesque	43	08	13·3	222	57	23·4	4·501584
Becker	90	45	39·5	270	38	25·4	4·158979
Greenwich	135	14	05·0	315	06	51·1	4·303497
Tilton	103	08	41·8	283	03	51·0	3·996239

BECKER.

In town of Easton, Washington Co., N. Y., 8 miles south of Greenwich, 3 miles west of Summit station. Owner, James E. Becker, living on west side; summit cleared of timber, except a fringe on southern edge.

[Latitude, 42° 59′ 58″·51. Longitude, 73° 31′ 40″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Adams	270	38	25·4	90	45	39·5	4·158979
Rafinesque							4·388452

RAFINESQUE.

Triangulation station, Mount Rafinesque, of the U. S. C. & G. S., 4 miles northeast of Lansingburg, Rensselaer Co., N. Y.; local name, Bald Mountain. Summit bald. Jacob Hayner lives on south side.

Permanent mark: Hole drilled in rock.

[Latitude, 42° 47′ 21″·15. Longitude, 73° 36′ 38″·81.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Greenwich	191	12	03·2	11	15	46·8	4·581978
Tilton	205	10	47·6	25	16	47·3	4·449087
Adams	222	57	23·4	43	08	13·3	4·501584
Becker							4·388452

MOUNT MERINO.

Primary triangulation station of the New York State survey and also of the U. S. C. & G. S. Situated in Greenport town, Columbia Co., N. Y., on a high hill 2 miles southwest of Hudson.

Permanent mark: Stone monument.

[Latitude, 42° 14′ 05″·06. Longitude, 73° 49′ 03″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Powell	167	25	35·3	347	23	42·8	4·244611
Windham	108	26	58·6	288	13	49·8	4·451936

SLIDE.

Not occupied. On the highest peak in the Catskill Mountains in Shandaken town, Ulster Co., N. Y., 8 miles south of Shandaken post-office. Point sighted is an observatory.

[Latitude, 41° 59′ 56″·97. Longitude, 74° 28′ 10″·94.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Vly	170	34	05·6	350	31	52·4	4·443943
Windham	209	42	44·8	29	52	31·9	4·606561

VLY.

A high, flat, heavily-wooded summit, 5 miles west of Lexington, Greene Co., N. Y. Instrument mounted on a large birch tree on southeast side of summit, about 50 feet lower than the highest part of summit. From here can be had a good view in all directions, excepting westward.

Permanent mark: Large birch tree.

[Latitude, 42° 14′ 45″·50. Longitude, 74° 26′ 29″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pisgah	227	50	09·8	47	58	05·3	4·338470
Windham	252	35	58·1	72	48	00·2	4·410953
Hunter	......	......	......	......	......	......	4·279210
Slide	350	31	52·4	170	34	05·6	4·443943
Utsayantho	144	18	50·3	324	12	50·5	4·321234

HUNTER.

A high, flat, wooded summit, 4 miles by trail south of Hunter, Greene Co., N. Y. An old observatory, 55 feet high, was strengthened and used to mount theodolite on.

[Latitude, 42° 10′ 39″·50. Longitude, 74° 18′ 49″·31.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Vly	......	......	......	......	......	......	4·279210
Pisgah	176	49	01·9	356	48	25·5	4·347139
Windham	205	10	28·1	25	13	58·6	4·226756

UTSAYANTHO.

Not occupied. Situated in town of Stamford, Delaware Co., N. Y.

Point sighted is the new observatory and probably is some distance from the New York Survey station.

[Latitude, 42° 23′ 56″·72. Longitude, 74° 35′ 24″·02.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Pisgah	274 42 04·4	94 56 00·8	4·454553
Vly	324 12 50·5	144 18 50·3	4·321234

WINDHAM.

Station 7 miles east of Windham Center, Greene Co., N. Y. Best reached by trail, 2 miles long, from house of M. E. Sherman, who lives on west side. An old observatory, 22 feet high, was used to elevate instrument, as the summit of the mountain is flat and heavily wooded.

Permanent mark: Hole drilled in rock with arrowheads cut in rock pointing to center.

[Latitudo, 42° 18′ 53″·78. Longitude, 74° 08′ 36″·22.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Hunter	25 13 58·6	205 10 28·1	4·226756
Pisgah	129 39 04·2	309 34 56·9	4·037701
Rundell	206 04 13·1	26 07 56·1	4·236302
Vly	72 48 00·2	252 35 58·1	4·410953
Powell	250 13 26·5	70 24 48·9	4·388157
Slide	29 52 31·9	209 42 44·8	4·606561

PISGAH.

Seven miles by wagon road north of Windham Center, Greene Co., N. Y., and 7 miles west-southwest of Durham. Summit entirely bare of timber. Instrument set up in front of hotel and angles reduced to center of cupola.

[Latitude, 42° 22′ 39″·18. Longitude, 74° 14′ 43″·27.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Powell	267 32 25·1	87 47 50·3	4·497277
Mount Merino			4·587860
Windham	309 34 56·9	129 39 04·2	4·037701
Rundell			4·257658
Hunter	356 48 25·5	176 49 01·9	4·347139
Vly	47 58 05·3	227 50 09·8	4·338470
Utsayantho	94 56 00·8	274 42 04·4	4·454553

RUNDELL.

One and a half miles northwest from Westerlo, Albany Co., N. Y. H. H. Rundell lives on southeast side. O. A. Mabey, owner of land, lives on west side.

[Latitude, 42° 27′ 15″·27. Longitude, 74° 03′ 04″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters*
Windham	26	07	56·5	206	04	13·1	4·236302
Pisgah							4·257658
Powell	295	06	06·3	115	18	41·1	4·231191

POWELL.

Primary triangulation station of the U. S. C. & G. S., situated on a hill in New Baltimore town, Greene Co., N. Y., about 3 miles northwest of West Coxsackie. Point well known by residents near there.

Permanent mark: Iron cone 18 inches below surface. Pile of rocks above cone.

[Latitude, 42° 23′ 20″·60. Longitude, 73° 51′ 50″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Windham	70	24	43·9	250	13	26·5	4·388157
Rundell	115	18	41·1	295	06	06·3	4·231191
Mount Merino	347	23	42·8	167	25	35·3	4·244611

SKY TOP TOWER.

Not occupied. The tower standing on most elevated ground near Lake Mohawk, Ulster Co., N. Y., about 15 miles south-southwest of Kingston.

Permanent mark: Center of tower.

Latitude, 41° 45′ 49″·76. Longitude, 74° 09′ 23″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pink	210	55	12·2	30	59	36·8	4·250418
Kingston City Hall	216	10	16·1	36	16	40·1	4·351719
Boice	235	43	38·3	55	56	53·8	4·321707
Lloyd	253	57	07·3	74	07	53·3	4·366092

KINGSTON CITY HALL.

City Hall, between Kingston and Rondout, Ulster Co., N. Y. Instrument mounted on tripod, 7 feet high, inside of top of tower.

Permanent mark: Center of tower.

[Latitude, 41° 55′ 37″·46. Longitude, 73° 59′ 47″·90.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boice	267	47	03·4	87	53	55·4	4·152789
Lloyd	322	13	30·2	142	17	53·0	4·171246
Sky Top Tower	36	16	40·1	216	10	16·1	4·351719
Pink	55	12	23·8	235	10	24·2	3·701074

TRAVER.

Triangulation station of the U. S. C. & G. S., on land owned by Mr. Traver, 2½ miles southeast of Rhinebeck village, Dutchess Co., N. Y. Highest hill in the vicinity.

Permanent mark: Iron cone 2 feet below surface.

[Latitude, 41° 55′ 05″·04. Longitude, 73° 52′ 41″·44.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Burhans	147	55	31·8	327	52	29·6	4·072218
Upper Red Hook	193	22	23·8	13	23	44·7	4·080424

TERRY.

A triangulation station of the U. S. C. & G. S., in northeast part of city of Kingston, Ulster Co., N. Y., one-fourth of a mile west of river and 309 feet above it, 100 yards from edge of bluff.

Permanent mark: Stone monument 1 foot square projecting 2 feet above ground.

[Latitude, 41° 56′ 22″·29. Longitude, 73° 58′ 19″·53.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lloyd	331	44	29·4	151	47	53·7	4·172733
Prospect	354	36	18·5	174	36	38·3	3·861053
Boice	273	56	11·9	94	02	04·9	4·086314

PROSPECT.

Triangulation station of the U. S. C. & G. S., in Ulster Co., N. Y., on a rounded hill, wooded on west side, and cleared on east side, situated 3 miles south of Rondout and east of the northern Esopus ponds. Amaziah Niese, owner of land.

Permanent mark: Iron cone with rock piled around it.

[Latitude, 41° 52′ 27″·96. Longitude, 73° 57′ 49″·92.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Terry	174	36	38·3	354	36	18·5	3·861053
Lloyd	312	44	37·6	132	47	41·6	3·937784
Boice	240	54	40·1	61	00	18·0	4·118791
Barnes	309	37	05·2	129	41	38·0	4·068583

BOICE.

In Dutchess Co., N. Y., in southwest corner of town of Milan. Station on high, bare hill, one-half mile north of Enterprise, almost on Rhinebeck town line; 6 miles by road east of Rhinebeck village.

Permanent mark of U. S. C. &. G. S. could not be found.

Reference mark: Blazed chestnut tree south 1° 15′ west (true) 109·3 feet.

[Latitude of new station, 41° 55′ 54″·81. Longitude, 73° 49′ 31″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Prospect	61	00	13·0	240	54	40·1	4·118791
Terry	94	02	04·9	273	56	11·9	4·086314
Lloyd	22	45	13·4	202	42	44·6	4·123825
Kingston City Hall	87	53	55·4	267	47	03·4	4·152789
Hussey Hill	69	59	36·5	249	52	49·4	4·17470
Sky Top Tower	55	56	53·8	235	43	38·3	4·521707
Pink	79	33	25·4	259	24	33·9	4·270619

LLOYD.

Triangulation station of the U. S. C. & G. S. in Dutchess Co., N. Y., in eastern part of town of Hyde Park, 3½ miles northeast of village, and 8 miles southeast of Staatsburg.

Permanent mark: Iron cone just below surface.

[Latitude, 41° 49′ 17″·24. Longitude, 73° 53′ 14″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Prospect	132	47	41·6	312	44	37·6	3·937784
Boice	202	42	44·6	22	45	13·4	4·123825
Terry	151	47	53·7	331	44	29·4	4·172733
Kingston City Hall	142	17	58·0	322	13	30·2	4·171246
Hussey Hill	128	42	24·5	308	38	06·6	4·05768
Sky Top Tower	74	07	58·3	253	57	07·3	4·366992

PINK.

In town of Hurley, Greene Co., N. Y., one-eighth of a mile southwest of corner of Ulster and Rosendale. Three miles southwest of Kingston, on highest land in vicinity. Summit nearly cleared of timber. J. M. Pink, owner of land.

Permanent mark: Stone monument; copper bolt stamped U. S. G. S., 463, N. Y.

Distance to large chestnut tree southwest, 29 feet; distance to property line southward, 17·7 feet.

[Latitude, 41° 54′ 04″·50. Longitude. 74° 02′ 46″·89.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kingston City Hall	235	10	24·2	55	12	23·8	3·701074
Boice	259	24	33·9	79	33	25·4	4·270619
Hussey Hill	291	52	47·9	111	54	52·3	3·66530
Sky Top Tower	30	59	36·8	210	55	12·2	4·250418

HUSSEY HILL.

Not occupied. In Ulster Co., N. Y., about 2 miles south of Rondout. A high, wooded ridge, with some timber cut down on summit.

Permanent mark: A lone tree in gap in timber.

[Latitude, 41° 53′ 08″·54. Longitude, 73° 59′ 40″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pink	111	54	52·3	291	52	47·9	3·66530
Boice	249	52	49·4	69	59	36·5	4·17470
Lloyd	308	38	06·6	128	42	24·5	4·05768

WOMELSDORF.

Triangulation station of the U. S. C. & G. S. in Lebanon Co., Pa., 4½ miles southwest of Womelsdorf, a station on the Phil. and Reading R. R., Pa. Summit of mountain was covered with a growth of saplings 15 to 20 feet high, some of which were cut down, giving view east and south.

Permanent mark: Bolt in rock.

[Latitude, 40° 19′ 28″·25. Longitude, 76° 11′ 44″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wernersville East Tower	282	42	59·5	102	47	42·5	4·024894
Wernersville West Tower	286	46	46·5	106	50	34·8	3·989816
Black Spot Tower	264	06	01·5	84	17	24·4	4·398460
Port Clinton	209	08	23·76	29	16	21·97	4·5511773

KREUTZER.

A hill 3 miles west-northwest of Allentown, Lehigh Co., Pa. John Kreutzer, owner, lives on north side one-eighth of a mile from station. Summit cleared, except on west end.

Permanent mark: Three blazes near foot of large chestnut tree.

[Latitude, 40° 37′ 15″·58. Longitude, 75° 31′ 42″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Rock	309	05	05·7	129	08	37·6	3·994259
Topton	39	22	00·6	219	15	59·0	4·315038

BAKE OVEN.

Triangulation station of the U. S. C. & G. S. in the northern part of Heidelberg Township, Lehigh Co., Pa., on a very prominent peak known as Bake Oven. It is 7 miles west-northwest from Slatington, on the Lehigh Valley Railroad, and about 4 miles north from Germansville, on the Schuylkill and Lehigh branch of the Reading Railroad. Station is about 6 feet from the edge of the precipice near the highest point of the peak.

Permanent mark: A foxtail bolt driven into the rock in a trench 2 feet below surface. The letters U. S. C. S., 1875, are cut on the rock to south of station, and also an arrow pointing to center.

[Latitude, 40° 44′ 54″·11. Longitude, 75° 44′ 02″·22.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Port Clinton......	53	42	39·16	233	32	35·87	4·3313338
Topton	351	48	49·1	171	50	48·9	4·483350
Bears Head......	111	19	09·8	291	05	36·1	4·495771

TOPTON.

Triangulation station of the U. S. C. & G. S. Station is about 3 miles south of Topton Railroad Station, Berks Co., Pa.; identified by iron bolt in huge bowlder. Nearly all the timber is now cut down (August, 1892).

[Latitude, 40° 28′ 37″·49. Longitude, 75° 40′ 58″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bake Oven........	171	50	48·9	351	48	49·1	4·483350
Long	6	39	49·2	186	39	06·7	4·124723
Fancy Hill........	8	57	50·3	188	56	36·5	4·236914
Big Rock	244	45	03·9	64	54	36·8	4·360514
Kreutser	219	15	59·0	39	22	00·6	4·315038

BIG ROCK.

Triangulation station of the U. S. C. & G. S. Three and one-half miles south of Allentown, Lehigh Co., Pa. This station was identified by a bolt in solid rock. Summit is now cleared of timber.

[Latitude, 40° 33′ 53″·73. Longitude, 75° 26′ 16″·42.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Topton	64	54	36·8	244	45	03·9	4·360514
Kreutser	129	08	37·6	309	05	05·7	3·994259

BLACK SPOT TOWER.

At Reading, Berks Co., Pa. Summit of mountain leveled off and lowered about 10 feet and all marks of U. S. C. & G. S. destroyed. A stone hotel, tower, and other buildings have been erected on summit. Instrument was mounted on roof of stone tower 50 feet above ground.

Permanent mark: Center of tower.

[Latitude, 40° 20′ 50″·32. Longitude, 75° 54′ 09″·73.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Womelsdorf	84	17	24·4	264	06	01·5	4·398460
Long	266	01	09·8	86	08	59·8	4·234802
Fancy Hill	279	17	43·5	99	25	02·1	4·209785

FANCY HILL.

In southern central part of Earl Township, Berks Co., Pa., 15 miles b road east of Reading. A good view to be had in all directions except east

Permanent mark: A tall, lone tree on western edge of woods.

[Latitude, 40° 19′ 24″·89. Longitude, 75° 42′ 52″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black Spot Tower	99	25	02·1	279	17	43·5	4·209785
Topton	188	56	36·5	8	57	50·3	4·236914

LONG.

A flat ridge in northeast portion of Earl Township, one-fourth of a mile south of Shanesville, Berks Co., Pa. John Kuser lives on southeast side.

Permanent mark: A pile of rocks S. 40° E. (Mag.) 70 feet distant from a large hickory tree.

[Latitude, 40° 21′ 28″·35. Longitude, 75° 42′ 03″·79.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black Spot Tower	86	08	59·8	266	01	09·8	4·234802
Topton	186	39	06·7	6	39	49·2	4·124728

MONTOUR.

Triangulation station of the U. S. C. & G. S. Station is on Montour ridge, Northumberland Co., Pa., 3½ miles north of the town of Northumberland.

Permanent mark: A stone monument.

[Latitude, 40° 56′ 29″·82. Longitude, 76° 49′ 00″·42.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Catawissa	270	23	03	90	38	25	4·517488
Barry	304	32	18	124	47	32	4·600208

WOODRUFF.

On a cleared ridge owned and cultivated by Mr. Woodruff, 2 miles northwest of Elysburg, Northumberland Co., Pa., and 3 miles north of Reeds Station (Reading Railroad). Mr. Woodruff lives on north side of ridge and from his house a wagon can be taken to station.

Permanent mark: A sharp-pointed rock buried in ground, top just above surface.

[Latitude, 40° 52′ 45″·62. Longitude, 76° 34′ 38″·08.]

To station	Asimuth.			Back asimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Catawissa	242	17	45	62	23	39	4·154306
Mahanoy (1)......	42	59	36	222	54	00	4·247612
Mahanoy (3)......	4	59	42	184	59	09	4·139748

WHITE HORSE.

Triangulation station of the U. S. C. & G. S. is on the Blue ridge, near the boundary line between Bethel Township, Berks Co., and Washington Township, Schuylkill Co., Pa.; station about 4½ miles south of Rock, a station on the Schuylkill and Susquehanna branch of the Reading railroad.

Permanent mark: A two-quart earthen jar buried base upward 2 feet below surface; 2 inches above jar is a flat stone, 15 by 18 inches, with a hole drilled in upper surface exactly over center of jar; above stone is a monument 2 feet long, which projects 8 inches above ground.

[Latitude, 40° 30′ 55″·19. Longitude, 76° 17′ 33″·95.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Port Clinton......	248	47	23·41	68	59	09·65	4·4376100
Governor Dick....	24	55	46·04	204	49	25·64	4·5175295
Barry.............	155	06	50·0	335	01	32·00	4·4348730

KNOB (2).

Not occupied. A well defined summit in the northeastern corner of Center Township, Columbia Co., Pa. Samuel H. Sitler lives on south side three-fourths of a mile from top.

Permanent mark: A very tall pine trimmed up.

[Latitude, 41° 05′ 44″·16. Longitude, 76° 20′ 46″·41.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald...............	233	16	20·0	53	39	52	4·792642
Penobscot........	256	11	39·0	76	30	20	4·611840

WYOMING.

Not occupied. A partly cleared summit 2 miles north of Wyoming, Luzerne Co., Pa., in southwest part of Exeter Township. Land owned by Hannah Whip. John S. Allen lives near triangulation station, 2 miles north of Wyoming and one-half mile southeast of camp ground.

Permanent mark: A pile of rocks.

[Latitude, 41° 20′ 54″·16. Longitude, 75° 50′ 39″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald	221	15	31	41	19	12	4·071414
Penobscot	7	21	54	187	20	47	4·268823

PORT CLINTON.

Triangulation station of the U. S. C. & G. S. Is on the second of the Blue Ridge Mountains, 5 miles northeast of Port Clinton, Schuylkill Co., Pa., a station on the Philadelphia and Reading Railroad.

Permanent mark: A square-headed bolt wedged between the rocks about 1 foot below the surface. Twelve feet north of station is a precipice; west of station about 200 feet are hemlock trees. Four holes are drilled in neighboring rocks, so that lines joining opposite holes intersect over station.

[Latitude, 40° 36′ 15″·05. Longitude, 75° 59′ 27″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black Spot (C. S. Sta.)	345	14	45·21	165	18	11·61	4·4693132
Womelsdorf	29	16	21·97	209	08	23·76	4·5511773
Bake Oven	233	32	35·87	53	42	39·16	4·3313333
White Horse	68	59	09·65	248	47	23·41	4·4376100
Barry	111	58	44·00	291	41	38·00	4·600257
Frackville							4·463389
Bears Head	164	40	37·60	344	37	08·90	4·452562

NESCOPECK (2).

On Nescopeck Mountain, Luzerne Co., Pa., 1 mile east of gap where Berwick and Hazleton pike crosses and 7½ miles east of Berwick; summit long and narrow and timbered with oak and hickory.

Permanent mark: Three blazes on trunk of lone hickory tree near ground.

[Latitude. 41° 02′ 13″·91. Longitude, 76° 05′ 03″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shickshinny	158	16	57	338	14	16	4·189199
Penobscot	227	40	47	47	49	08	4·380321

BROAD.

Not occupied. Station is situated on the highest point of Broad Mountain, Jackson town, Dauphin Co., Pa., about 5 miles southwest of Elizabethville. Station is marked by a pine tree.

[Latitude, 40° 30′ 39″·46. Longitude, 76° 46′ 13″·36.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Little Mahanoy ..	168	31	17	348	28	52	4·420220
Big Lick..........	234	04	32	54	10	30	4·203452

DAUPHIN.

Triangulation station of the U. S. C. & G. S. on the second Blue Mountain, 2 miles east of the village of Dauphin, Dauphin Co., Pa.

Permanent mark: A bottle 3 feet below surface, a stone over this, and monument on the stone. Four holes are drilled in neighboring rocks, so that lines joining opposite ones intersect over station. Bearings and distance from holes to station are north 43½° east 3·89 feet; north 69½° west 6·46 feet; south 43½° west 10·4 feet; south 69½° east 6·03 feet.

[Latitude, 40° 21′ 59″·05. Longitude, 76° 54′ 32″·71.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Governor Dick....	288	56	30·03	109	14	05·46	4·6103552
Round Top	2	51	18·42	182	50	38·75	4·4655097

BERRIES.

Station on Berries Mountain, about 2 miles southeast of Millersburg, Dauphin Co., Pa., one-third of a mile east of Lovers Rock. A wagon can be taken to triangulation station. Summit, long and narrow; three acres of timber cut down, giving a good view north and south, but not east or west.

Permanent mark: Blazes on three sides of lone tree.

[Latitude, 40° 31′ 37″·24. Longitude, 76° 55′ 54″·36.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Little Mahanoy...	199	16	15	19	20	08	4·405435
Big Lick..........	254	00	02	74	12	17	4·442001

BIG LICK.

On Big Lick Mountain, just north of Williamstown colliery, Dauphin Co., Pa. The station is on a slight rise of the long, straight, and nearly level mountain top.

Permanent mark: Stump 5 feet high, 6 inches diameter, with rocks piled round it.

[Latitude, 40° 35′ 42″·95. Longitude, 76° 37′ 08″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mahanoy (1)	155	21	02	335	19	05	4·311132
Barry	225	16	56	45	24	20	4·351990
Little Mahanoy	132	11	30	312	03	06	4·388997
Berries	74	12	17	254	00	02	4·442001

MAHANOY (3).

Not occupied. A knob of the Mahanoy Mountain 3 miles, S. 44° W. (mag.) from Shamokin, Northumberland Co., Pa., and in plain view from the city. About an acre of timber cut down.

Permanent mark: Tree blazed near foot.

[Latitude, 40° 45′ 20″·08. Longitude, 76° 35′ 24″·24.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Woodruff	184	59	09	4	59	42	4·129748
Catawissa	214	09	39	34	16	06	4·391414

KOCHER.

A high summit of the Alleghany or North Mountain, 3 miles (air line) west of Harvey Lake, in northern central part of Lake Township, Luzerne Co., Pa. Land owned by J. W. Kocher, who lives near Harvey Lake, on west side. Station reached by following a log road from Sylvester Kocher's to edge of summit; thence through woods to station. Timber cut from 2 or 3 acres.

Permanent mark: Rocks piled at foot of tripod near root of tree.

[Latitude, 41° 21′ 28″·05. Longitude, 76° 07′ 04″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ricketts	71	16	43	251	09	07	4·229097
Miller	223	26	10	43	32	44	4·303396
Penobscot	313	21	50	133	31	32	4·451850

LITTLE MAHANOY.

Station on high peak at extreme western end of Mahanoy Mountain 3 miles (air line) north of Herndon, Northumberland Co., Pa. Timber cut down, giving a fine view in all directions except eastward. Sides are steep and rocky, making ascent difficult.

Permanent mark: Tree blazed; also a pile of rocks 23 feet east of tree.

[Latitude, 40° 44′ 35″·47. Longitude, 76° 49′ 56″·57.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mahanoy (1)	257	12	18	77	16	45	3·993262
Big Lick	312	03	06	132	11	30	4·388997
Berries	19	20	08	199	16	15	4·405435

MAHANOY (2).

On the Mahanoy range, 4 miles southeast of Trevorton, Northumberland Co., Pa., and 5 miles southwest of Shamokin, in Coal Township. Station on west end of a long, sharp, and nearly level summit heavily timbered. Charles Kramer lives on southeast side of mountain, one-half mile from triangulation station.

Permanent mark: Blazes on foot of tree.

[Latitude, 40° 45′ 28″·87. Longitude, 76° 37′ 07″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mahanoy (1)	93	36	31	273	32	36	3·926584
Catawissa	218	56	35	39	04	09	4·412599

MAHANOY (1).

A prominent knob on the Mahanoy Mountain, 3 miles west southwest of Trevorton, Northumberland Co., Pa. The station can be reached by driving west from Trevorton 2 miles, then turning south up an old wood road, and then walking up the steep mountain side three-fourths of a mile. Summit nearly clear of timber.

Permanent mark: Blaze on foot of tree.

[Latitude, 40° 45′ 45″·95. Longitude, 76° 43′ 07″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Catawissa	231	30	32	51	42	01	4·498371
Barry	276	24	18	96	35	40	4·392270
Mahanoy (2)	273	32	36	93	36	31	3·926584
Little Mahanoy	77	16	45	257	12	18	3·993262
Woodruff	222	54	00	42	59	36	4·247612
Big Lick	335	19	05	155	21	02	4·311132

BARRY.

Triangulation station of the U. S. C. & G. S., on the highest par of the Mahantango Mountain, 6½ miles southwest of Ashland, Schuylki Co., Pa. Summit flat and partly timbered. Instrument elevated 1 feet.

Permanent mark: Hole drilled in rock 5 by 5 by 36 inches.

[Latitude, 40° 44′ 15″·39. Longitude, 76° 25′ 42″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Port Clinton	291	41	38	111	58	44	4·600257
White Horse	335	01	32	155	06	50	4·434878
Mahanoy (1)	96	35	40	276	24	18	4·392270
Catawissa	180	32	26	0	32	32	4·349496
Big Lick	45	24	20	225	16	56	4·351990
Montour	124	47	32	304	32	18	4·600208
Frackville	256	11	37	76	18	18	4·171151

FRACKVILLE.

On the crest of the Broad Mountain 2½ miles southwest of Frackville Butler Township, Schuylkill Co., Pa. A wagon can be taken within one-fourth of a mile of triangulation point. Tripod, 12 feet high, erected on highest part and 52 feet southwest of partly dead pine tree; summit flat and covered with bushes about 10 feet high.

Permanent mark: Rocks piled up at foot of tree and tree blazed.

[Latitude, 40° 46′ 09″·67. Longitude, 76° 15′ 28″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Barry	76	18	18	256	11	37	4·171151
Bears Head	239	00	13	59	07	12	4·243035
Port Clinton							4·463389
Buck	182	51	34	2	52	02	4·302861

BEARS HEAD.

Triangulation station of the U. S. C. & G. S. In Rush Township, Schuylkill Co., Pa., 1 mile from Delano on Lehigh Valley Railroad. Summit flat and covered with pine trees. Instrument elevated 35 feet.

Permanent mark: Monument, 5 by 14 inches on top, 3 feet long.

[Latitude, 40° 51′ 01″·35. Longitude, 76° 04′ 47″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Port Clinton	344	37	08·9	164	40	37·6	4·452562
Bake Oven	291	05	36·1	111	19	09·8	4·495771
Catawissa	108	45	38·0	288	32	03·0	4·488122
Buck	128	23	43·0	308	17	12·0	4·251213
Shickshinny	170	09	41·0	350	06	50·0	4·551844
Frackville	59	07	12·0	239	00	13·0	4·243035

CATAWISSA.

Triangulation station of the U. S. C. & G. S. Two miles (air line) southeast of town of Catawissa, Columbia Co., Pa. Summit very broad and much timber still standing. Ascent difficult, as no road runs near triangulation point. Instrument elevated 15 feet.

Permanent mark: Hole drilled in rock.

[Latitude, 40°, 56′ 20″·28. Longitude, 76° 25′ 33″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bears Head	288	32	03	108	45	38	4·488122
Barry	0	32	32	180	32	26	4·349496
Mahanoy (3)	34	16	06	214	09	39	4·391414
Mahanoy (2)	39	04	09	216	56	35	4·412599
Mahanoy (1)	51	42	01	231	30	32	4·498371
Woodruff	62	23	39	242	17	45	4·154306
North	165	40	23	345	35	18	4·639609
Montour	90	38	25	270	23	03	4·517488

BUCK.

Not occupied. In eastern part of Beaver Township, 3 miles east of Beaver Valley, Columbia Co., Pa. Summit flat and round; the edges covered with a scattering growth of pines; a tripod 15 feet high erected near a leaning pine tree on highest part. Abel Smith and Isaac Klingerman (guides) live on northwest side 1½ miles from triangulation point.

Permanent mark: Blaze on foot of tree.

[Latitude, 40° 57′ 00″·00. Longitude, 76° 14′ 46″·22.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bears Head	308	17	12	128	23	43	4·251213
Frackville	2	52	02	182	51	34	4·302861

NESCOPECK (3).

On the Nescopeck mountain, south of Mifflinville, Columbia Co., Pa., half a mile from field of Jonathan Spaid. From Bloomsburg take Berwick road for 6 miles, crossing river at Stonytown Ferry. Summit narrow and rocky; trees are cut down giving a fine view northward.

Permanent mark: Blazes on tree trunk.

[Latitude, 40° 59′ 08″·98. Longitude, 76° 18′ 46″·16.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shickshinny	213	50	27	33	56	46	4·383323
Penobscot	239	16	59	59	34	20	4·632961

NESCOPECK (1.)

Not occupied. On the Nescopeck Mountain, Luzerne Co., Pa., abou 1 mile east of where Wilkesbarre and Hazleton turnpike crosses an near the corner of Dorrance, Butler, Dennison, and Wright townships

Permanent mark : A tall pine near eastern end of summit.

[Latitude, 41° 05′ 04″·29. Longitude, 75° 56′ 27″·47.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shickshinny......	117	12	40	297	04	19	4·300080
Penobscot........	207	44	15	27	46	57	4·089938

SHICKSHINNY.

One and a half miles from the town of Shickshinny, Luzerne Co., Pa., and on the range east of the gap known locally as "The Lookout."

Permanent mark: Hole drilled in rock.

[Latitude, 41° 09′ 59″·40. Longitude, 76° 09′ 08″·77.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Penobscot........	265	34	07	85	45	10	4·371794
Bears Head.......	350	06	50	170	09	41	4·551844
Nescopeck (1)....	297	04	19	117	12	40	4·300080
Nescopeck (3).....	33	56	46	213	50	27	4·383323
Glen Summit.....	274	23	47	94	36	03	4·417360

NORTH.

A summit of the North Mountain in western part of Davidson Township, Columbia Co., Pa.; local name, Round Top; 1 mile north of Billy Backbone Mountain. A tripod, with target, was erected by the U. S. . & G. S. during 1886 and sighted from Catawissa. Summit about 50 yards across, east and west, and 200 yards long, north and south. It is covered with a scattering growth of bushes and trees from 10 to 20 feet high.

Mark: A + cut in rock.

[Latitude, 41° 19′ 09″·97. Longitude, 76° 33′ 17″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ricketts..........	273	16	15	93	25	58	4·313063
Catawissa........	345	35	18	165	40	23	4·639609

RICKETTS.

Triangulation station of the U. S. C. & G. S. Is very near the southeast corner of Sullivan Co., Pa., on the North Mountain. The station is from one-half to three-fourths mile from the main road, on the highest ground within a distance of 2 or more miles. There is a hotel at foot of the mountain, distance by road 2 miles, and one at Ganoga Lake, distance 3½ miles.

Permanent mark: A stone with hole drilled in it.

Reference mark: Azimuth C. & G. S station to tree 119°; distance, 74·9 feet.

[Latitude, 41° 18′ 31″·13. Longitude, 76° 18′ 34″·67.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald	253	57	27	74	19	34	4·68625
Penobscot	290	47	00	111	04	17	4·59340
Kocher	251	09	07	71	16	43	4·229097
North	93	25	58	273	16	15	4·318063

GLEN SUMMIT.

Not occupied. Station on the high ridge 1½ miles due east (mag.) of Glen Summit, Luzerne Co., Pa. A station on the Lehigh Valley Railroad. Summit rounded with a few scattering trees standing.

Permanent mark: Blazes on tree near foot.

[Latitude, 41° 08′ 53″·00. Longitude, 75° 50′ 30″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shickshinny	94	36	03	274	23	47	4·417360
Penobscot	145	54	08	325	52	55	3·664854

PENOBSCOT.

Triangulation station of the U. S. C. & G. S. It is on the Wilkesbarre Mountain, in Luzerne Co., Pa., about 3 miles south of Wilkesbarre and three-fourths of a mile from Fairview Station, on the Lehigh Valley Railroad, and same distance from Solomons Gap, on Lehigh and Susquehanna Railroad. Summit entirely bare.

Permanent mark: Hole drilled in rock.

[Latitude, 41° 10′ 57″·14. Longitude, 75° 52′ 21″·83.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pimple Hill	290	08	05·0	119	22	35·1	4·548991
Knob (C. & G. S.)	353	26	55·3	173	28	37·9	4·506182
Kocher	133	31	32·0	313	21	50·0	4·451850
Wyoming	187	20	47·0	7	21	54·0	4·268823
Nescopeck (1)	27	46	57·0	207	44	15·0	4·089938
Knob (2)	76	30	20·0	256	11	39·0	4·611840
Glen Summit	325	52	55·0	145	54	08·0	3·664854
Nescopeck (3)	59	34	20·0	239	16	59·0	4·632961
Ricketts	111	04	17·0	290	47	00·0	4·59340
Bald Mountain	200	23	53·0	20	28	42·0	4·463994
Nescopeck (2)	47	49	08·0	227	40	47·0	4·380321
Miller	168	56	13·0	348	53	08·0	4·540332
Shickshinny	85	45	10·0	265	34	07·0	4·371794

MILLER.

Three miles (air line) south of Tunkhannock, Wyoming Co., Pa., and 8 miles by the road. Summit flat, with large trees on southeast side.

Permanent mark: Stone with cross cut in top.

[Latitude, 41° 29′ 20″·95. Longitude, 75° 50′ 08″·86.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Mountain ...	291	54	08	112	02	07	4·258096
Penobscot	348	53	03	168	56	13	4·540332
Kocher	43	32	44	223	26	10	4·303396

JERMYN.

Not occupied. A bald ridge in southwest corner of Carbondal Township and west of village of Jermyn, Lackawanna Co., Pa.

Permanent mark: A lone pine tree.

[Latitude, 41° 32′ 29″·01. Longitude, 75° 34′ 28″·58.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Mountain ...	49	37	20	229	30	19	4·287687
Elk	183	22	15	3	22	48	4·285792

SALEM.

Triangulation station of the U. S. C. & G. S. on the top of the mountain, 2½ miles east of Carbondale. Summit entirely bare.

[Latitude, 41° 33′ 01″·48. Longitude, 75° 27′ 26″·00.]

To station.	Azimuth.			Back aziumth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Mountain ...	61	09	36	240	57	54	4·448229
Elk	154	43	14	334	39	07	4·305702

BALD MOUNTAIN.

Triangulation station of the U. S. C. & G. S. on the summit of Bald Mountain.

Permanent mark: Cross marks cut in bowlders.

[Latitude, 41° 25′ 41″·24. Longitude, 75° 45′ 04″·92.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Panther	335	42	02	155	46	35	4·369701
Penobscot	20	28	42	200	23	53	4·463994
Bald (3)...........	230	13	54	50	26	48	4·54596
Miller	112	02	07	291	54	08	4·258096
Elk	206	26	04	26	33	39	4·551398
Ricketts...........	74	19	34	253	57	27	4·68625
Salem	240	57	54	61	09	36	4·448229
Jermyn............	229	30	19	49	37	20	4·287687

BALD (3).

Not occupied. In Wayne Co., Pa. On a bald summit of the mountain, about 3 miles north of Fairview, a station on the gravity railroad, in the western central part of Clinton Township.

Permanent mark: A tall, dead tree.

[Latitude, 41° 37′ 48″·3. Longitude, 75° 25′ 37″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Mountain	50	26	48	230	13	54	4·54596
Elk	130	16	47	310	11	27	4·10426

ELK.

In southwest corner of Herrick Township, Susquehanna Co., Pa., 4 miles from Union Dale. Norris Burdick lives on eastern side of mountain three-fourths of a mile from triangulation station.

Permanent mark: A rock sunk in ground and cross cut in top.

[Latitude, 41° 42′ 53″·84. Longitude, 75° 33′ 39″·44.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Moosic	349	15	19	169	17	55	4·466890
Bald Mountain	26	33	39	206	26	04	4·551398
Bald (3)	310	11	27	130	16	47	4·164260
Salem	334	39	07	154	48	14	4·305702
Jermyn	30	22	48	183	22	16	4·285792

SOUTHERN APPALACHIAN REGION.

METHODS OF WORK.

Portions of Virginia, West Virginia, and Maryland lying north of latitude 39° and between longitudes 78° and 80° were controlled by triangulation in 1884 by W. T. Griswold, assisted by L. C. Fletcher. This work was based upon the line Fork-Marshall of the U. S. Coast and Geodetic Survey. Angles were measured with a Schilling 6-inch theodolite, reading by vernier to 10 seconds.

Triangulation in the southwestern portion of Virginia was commenced in 1883 by Prof. J. H. Gore, assisted by G. F. Wakefield. A series of triangles and quadrilaterals was started at the line Paint-Ivy of the U. S. Coast and Geodetic Survey in Fayette County, W. Va., and extended southwestward for 100 miles through Scott, Wise, Dickinson, Buchanan, and Tazewell counties, Virginia, to the line Chimney-Holston in eastern Tennessee, previously established by triangulation party No. 1 of the Geological Survey.

The instrument used in this work was a Kübel 6-inch theodolite, reading by verniers to 10 seconds.

Two stations of this belt were used for extending triangulation into eastern Kentucky. This was done during 1884 by G. F. Wakefield, using a 6-inch theodolite, reading by verniers to 10 seconds.

All that portion of Virginia lying north and west of the Blue Ridge and west of the peaks of Otter which was without control was triangulated during 1885 and 1886 by S. S. Gannett, using a Fauth 7-inch theodolite, reading by verniers to 10 seconds.

In 1888 portions of the counties of Prince Edward and Buckingham were controlled by F. J. Knight, the work being based upon the U. S. Coast and Geodetic Survey line Smith-Long.

In 1889 Pittsylvania and Campbell counties were triangulated by C. M. Yeates, using a Fauth 7-inch theodolite, reading by verniers to 10 seconds.

In addition to the work previously mentioned as having been done in Kentucky, several stations were located in Harlan and Bell counties during 1885 by F. J. Knight, based upon stations of the Geological Survey, White Rocks-War Gap.

In 1888 and 1890 C. M. Yeates extended triangulation over that portion of Kentucky lying between the parallels of 37° and 38° and between the meridians of 83° and 85°.

The nature of this country made this work most difficult, the hills being of the same height and heavily timbered. Much time was spent

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in selecting stations and clearing them of timber, and even then only short lines of sight could be obtained.

A Fauth 7-inch (vernier) theodolite was used during the field season of 1888, and an 8-inch (micrometer) theodolite during 1890.

Triangulation was extended over the mountainous portion of western North Carolina and eastern Tennessee, between the Blue Ridge and the escarpment of the Cumberland Plateau during the field seasons of 1882, 1883, 1884, and 1885. This work was begun by Prof. W. C. Kerr at stations Benn and Poore of the U. S. Coast and Geodetic Survey in October, 1882. It was extended during 1883 by Prof. Kerr, assisted by S. S. Gannett, and further extended by the latter during 1884 and 1885.

A Kübel 6-inch (vernier) theodolite was used at first, which was replaced later by a Fauth 7-inch (vernier) theodolite.

In all of the work in the Appalachian Mountain region a lone tree has been commonly used as a signal. Most of the summits were found to be wooded. All trees obstructing the view were usually cut away. A tall symmetrical tree standing on the highest part of the summit was trimmed up and left as signal and mark. On bald summits a signal was usually made of saplings fastened together a few feet from the top and raised in form of a tripod.

In nearly all of the Appalachian triangulation a least square station and figure adjustment has been made.

DESCRIPTIONS AND POSITIONS OF STATIONS.

SINKING CREEK.

In Gilmer Co., W. Va., about 10 miles northwest of Glenville, at the head of Sinking Creek. Summit nearly cleared.

Permanent mark: Oak tree.

[Latitude, 39° 01′ 17″·6. Longitude, 80° 51′ 56″·8.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Sugar Loaf	266 51 20	87 02 45	4·41807
Rush	291 16 25	111 28 31	4·47475

MEADOWS, MD.

On summit.

[Latitude, 39° 34′ 13″·03. Longitude, 79° 12′ 24″·65.]

NAT, W. VA.

Lone tree on summit.

[Latitude, 39° 14′ 42″·41. Longitude, 78° 46′ 09″·03.]

BLOOMERY, W. VA.

Signal built on summit.

[Latitude, 39° 26′ 19″·00. Longitude, 78° 21′ 01″·63.]

KENNEDY, VA.

On summit.

[Latitude, 38° 44′ 30″·93. Longitude, 78° 29′ 16″·37.]

DAN, MD.

[Latitude, 39° 34′ 52″·64. Longitude, 78° 53′ 49″·69.]

HIGH ROCK, MD.

[Latitude, 39° 32′ 38″·57. Longitude, 79° 05′ 46″·38.]

PINNACLE, W. VA.

On summit.

[Latitude, 39° 22′ 54″·22. Longitude, 79° 04′ 40″·90.]

SUGAR LOAF.

In Lewis Co., W. Va., 10 miles southwest of Weston, at the head of Mullins Creek. Summit cleared on southern edge and wooded on northern edge.

Permanent mark: Oak tree.

[Latitude, 39° 02′ 02″·75. Longitude, 80° 33′ 49″·7.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Bear Knob........	263	48	06	83	58	27	4·377395
Rush	352	30	09	172	30	51	4·09247
Cedar Creek	64	22	45	244	10	08	4·50714
Locust	33	34	43	213	30	08	4·27965
Sinking Creek....	87	02	45	266	51	20	4·41807

BEAR KNOB.

Seven miles northwest of Buckhannon, in Upshur Co., W. Va. Sharp knob and a good point. Nearly all timber was cut down.

Permanent mark: Small tree.

[Latitude, 39° 03′ 25″·1. Longitude, 80° 17′ 23″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Laurel............	253	55	06·5	74	12	34·3	4·618122

LITTLE BALD.

In Harrison Co., W. Va., 7 miles northeast of Clarksburg and 4 miles north of Bridgeport. Summit entirely bald. Other knobs within 3 miles, of same height.

Permanent mark: None.

[Latitude, 39° 20′ 09″·1. Longitude, 80° 14′ 22″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bear Knob	8	00	05·8	187	58	11·4	4·495046
Nelson	241	16	54·2	61	28	30·1	4·475479
Laurel	298	44	03·7	118	59	40·1	4·607755

LAUREL.

Knob on Laurel hills, 15 miles east of Philippi, in Tucker and Barbour counties, W. Va., by very rough road.

Permanent mark: Tall dead tree standing alone.

[Latitude, 39° 09′ 34″·7. Longitude, 79° 49′ 42″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Little Bald	118	59	40·1	298	44	03·7	4·607755
Nelson	104	51	12·4	344	47	09·3	4·545381
Felton	210	47	31·9	30	54	14·2	4·472863
Green	310	59	41·7	181	14	14·8	4·646077
Bickles	341	27	56·0	161	31	35·4	4·421288
Bear Knob	74	12	34·3	253	55	06·5	4·618122

NELSON.

Twelve miles northeast of Grafton by rough road, at south point of Monongalia Co., W. Va.

Permanent mark: Chestnut tree, trimmed up.

[Latitude, 39° 27′ 53″·3. Longitude, 79° 56′ 06″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Little Bald	61	28	30·1	241	16	54·2	4·475479
Felton	288	52	24·2	109	03	11·51	4·411222
Laurel	344	47	09·3	164	51	12·4	4·545381

FELTON.

On Briery Mountain, 5 miles north of Rowlesburg, on Baltimore and Ohio Railroad, Preston Co., W. Va. Summit partly cleared.

Permanent mark: Locust tree.

[Latitude, 39° 23′ 21″·7. Longitude, 79° 39′ 07″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nelson	109	03	11·5	288	52	24·2	4·411222
Bickles	7	48	01·3	187	44	59·8	4·707488
Laurel	30	54	14·2	210	47	31·9	4·472863

PADDY KNOB.

Rounded knob on North Mountain, above Van Buren furnace on boundary between Shenandoah Co., Va., and Hardy Co., W. Va.

Permanent mark: Pine tree on State line.

[Latitude, 39° 00′ 24″·4. Longitude, 78° 33′ 47″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Capon	216	16	29·8	36	21	22·2	4·274894
Kennedy	347	26	18·2	167	29	07·8	4·478791
Mount Marshall	309	12	27·5	129	26	02·1	4·606572

CAPON.

On the line between Hampshire Co., W. Va., and Frederick Co., Va. On North Capon Mountain, on the Virginia and West Virginia State line. Point known as "Pinnacle," near Capon Springs.

Permanent mark: U. S. G. S., cut in rock.

[Latitude, 39° 08′ 36″·4. Longitude, 78° 26′ 3″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kennedy	5	57	47·0	185	55	45·2	4·651401
Mount Marshall	333	43	47·0	153	52	31·0	4·657576
Paddy Knob	36	21	22·2	216	16	29·8	4·274894

SUGAR LOAF.

A triangulation station of the U. S. C. & G. S. on the well known mountain in Frederick Co., Md.

[Latitude, 39° 15′ 44″·55. Longitude, 77° 23′ 36″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bull Run	32	29	22·17	212	17	38·93	4·6995519
Md. Heights	107	29	59·85	287	17	43·18	4·4654339
Stabler	293	45	40·15	114	01	09·32	4·5865133
Peach Grove	339	28	31·78	159	34	43·88	4·6079571

MARYLAND HEIGHTS.

A triangulation station of the U. S. C. & G. S. on the Blue Ridge, north of Harpers Ferry, in Washington Co., Md.

[Latitude, 39° 20′ 27″·69. Longitude, 77° 42′ 59″·91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sugar Loaf	287	17	43·18	107	29	59·85	4·4654339
Bull Run	358	43	10·10	178	43	39·95	4·7077533

PEACH GROVE.

A triangulation station of the U. S. C. & G. S. in Fauquier Co., Va.

[Latitude, 38° 55′ 12″·74. Longitude, 77° 13′ 46″·77.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bull Run	84	11	21·12	263	53	29·89	4·6162546

BULL RUN.

A triangulation station of the U. S. C. & G. S., on line between Fauquier and Prince William counties, Va.

[Latitude, 38° 52′ 53″·58. Longitude, 77° 42′ 12″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Md. Heights......	178	43	39·95	358	43	10·10	4·7077533
Clark	22	30	41·44	202	19	28·39	4·8354456
Sugar Loaf.........	212	17	38·93	32	29	22·17	4·6995519
Peach Grove......	263	53	29·89	84	11	21·12	4·6162546

MOUNT MARSHALL.

A triangulation station of the U. S. C. & G. S. on Blue Ridge, above Brownstown, on line between Warren and Rappahannock counties, Va.

Permanent mark: Copper bolt.

[Latitude, 38° 46′ 33″·82. Longitude, 78° 12′ 10″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Fork	29	26	43·21	209	18	44·29	4·5778087
Kennedy	81	24	03·30	261	13	20·80	4·3990680
Paddy Knob.......	129	26	02·10	309	12	27·50	4·6065720
Capon	153	52	31·00	333	43	47·00	4·6575760
High Top (C. S.)..	212	38	03·00	32	41	28·00	4·1640430
Clark..............	341	17	17·50	161	24	45·39	4·7358815
North	100	02	58·10	279	40	17·90	4·7253930

CLARK.

A triangulation station of the U. S. C. & G. S. in Orange Co., Va.

[Latitude, 38° 18′ 41″·11. Longitude, 78° 00′ 11″·49.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Marshall..	161	24	45·39	341	17	17·50	4·7358815
Bull Run.........	202	19	28·39	22	30	41·44	4·8354456

FORK.

A triangulation station of the U. S. C. & G. S. in Madison Co., Va., on Blue Ridge, about 5 miles south of crossing of road from Marksville to Criglersville, Va.

Permanent mark: Copper bolt.

[Latitude, 38° 28′ 44″·81. Longitude, 78° 24′ 57″·47.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kennedy	167	54	00·82	347	59	19·20	4·4748290
Mount Marshall	209	18	44·29	29	26	43·21	4·5778087
North	141	14	38·10	321	00	01·60	4·7326430
Rogers (Elliott Knob)	66	26	43·28	245	53	17·98	4·9338746
Slate Springs	93	09	32·89	272	40	51·08	4·8268669

NORTH.

On the line between Hardy Co., W. Va., and Shenandoah Co., Va., on North Mountain, 200 yards south of road crossing from Orkney Springs to Lost River post-office.

Permanent mark: Lone pine tree.

[Latitude, 38° 51′ 28″·9. Longitude, 78° 48′ 20″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Marshall	279	40	17·9	100	02	58·1	4·725393
Fork	321	00	01·6	141	14	38·1	4·732643
Spruce	75	41	13·5	254	13	53·0	4·817057
Green	94	43	04·3	274	19	03·3	4·744391
Slate Springs	40	34	29·3	220	20	17·1	4·705744

RICH.

In Randolph Co., W. Va., on Rich Mountain, about 2 miles south of turnpike from Beverly to Buckhannon. Scaffold erected on trees, but partially destroyed by lightning.

[Latitude, 38° 50′ 01″·85. Longitude, 79° 56′ 22″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bear	129	18	34	309	05	21	4·593183
Bickles	238	12	29	58	20	19	4·326353
Big Run	81	14	19	261	02	20	4·447491

BIG RUN.

In Upshur Co., W. Va., about 3½ miles (air line) southwest of Alton, on West Virginia and Pittsburg Railroad, at head of Big Run. Instrument on platform 93 feet high.

Permanent mark: Hickory tree.

[Latitude, 38° 47′ 41″·9. Longitude, 80° 15′ 30″·15.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bear	174	38	13	354	37	02	4·465596
Rich	261	02	20	81	14	19	4·447491
Rush	119	55	48	299	45	00	4·457860

RUSH.

In Lewis Co., W. Va., about 5 miles west of Roanoke (a station on the West Virginia and Pittsburg Railroad), at head of Canoe Run. Summit covered with trees, with gaps cut toward triangulation stations.

Permanent mark: Tree with scaffold around it.

[Latitude, 38° 55′ 25″·0. Longitude, 80° 32′ 42″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bear	236	07	01	56	16	39	4·425104
Big Run	299	45	00	119	55	48	4·457860
Cedar Creek	86	57	21	266	44	03	4·486370
Locust	73	30	40	253	25	23	4·102730
Sinking Creek	111	28	31	291	16	25	4·474750
Sugarloaf	172	30	51	352	30	09	4·092490

LOCUST.

In Gilmer Co., W. Va., sometimes called Hickory Knob, about 5 miles northeast of Stout Mills on Little Kanawha River at head of Sliding Hill Creek. Summit covered with timber. Scaffold was erected around tall tree and occupied as a secondary station.

Permanent mark: Tree.

[Latitude, 38° 53′ 28″·15. Longitude, 80° 41′ 06″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sugarloaf	213	30	08	33	34	43	4·27965
Rush	253	25	23	73	30	40	4·10273

CEDAR CREEK.

In Gilmer Co., W. Va., about 10 miles west of Glenville, at the head of Paddy Run, of Cedar Creek, and Spring Fork of Grassy Creek. Summit timbered, with gaps cut through toward triangulation stations.

Permanent mark: Tree with scaffold around it.

[Latitude, 38° 54′ 30″·3. Longitude, 80° 53′ 52″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sugarloaf	244	10	08	64	22	45	4·50714
Rush	266	44	03	86	57	21	4·48637

GREEN.

On line between Randolph and Pendleton counties, W. Va., on main chain of Alleghany Mountains, near head of Seneca River. Summit a long ridge, heavily timbered with spruce and hemlock. Thomas, on West Virginia Central Railroad, is the nearest railroad station.

Permanent mark: Spruce tree on south end.

[Latitude, 38° 53′ 50″·7. Longitude, 79° 26′ 36″·7.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Bickles	99	22	54·7	279	12	02·4	4·403926
Laurel	131	14	14·8	310	59	41·7	4·646077
North	274	19	03·3	94	43	04·3	4·744391
Spruce	19	35	56·3	199	32	33·7	4·367376
Panther	7	02	33·1	187	00	34·7	4·572369
Slate Springs	332	16	28·7	152	26	11·8	4·686270

BICKLES.

On Bickles Knob, on Cheat Mountain, in the northern central part of Randolph Co., W. Va. Philippi, 30 miles northwest, is nearest railroad station. Summit well cleared.

Permanent mark: Oak tree.

[Latitude, 38° 56′ 03″·4. Longitude, 79° 43′ 54″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bear Knob	105	54	26·0	285	33	21·6	4·701012
Laurel	101	31	35·4	341	27	56·0	4·421288
Felton	187	44	59·8	7	48	01·3	4·707488
Rich	58	20	19·0	238	12	29·0	4·326353
Green	279	12	02·4	99	22	54·7	4·403926
Spruce	326	25	45·0	146	33	13·1	4·494699

SPRUCE.

On Spruce Mountain, a long, barren, rocky ridge, 4 miles by rough trail from Circleville, Pendleton Co., W. Va.

Permanent mark: None.

[Latitude, 38° 41′ 58″·7. Longitude, 79° 31′ 59″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bickles	146	33	13·1	326	25	45·0	4·494699
Green	199	32	33·7	19	35	56·3	4·367376
North	254	13	53·0	74	41	13·5	4·817057
Panther	347	52	02·0	167	53	25·8	4·189382
Slate Springs	304	36	56·9	124	50	00·5	4·567880

PANTHER.

On Panther Knob, at southwest corner of Pendleton Co., W. Va., near Highland County line.

Permanent mark: Small tree.

[Latitude, 38° 83′ 48″·3. Longitude, 79° 29′ 45″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spruce	167	53	25·8	347	52	02·0	4·189882
Green	187	00	34·7	7	02	33·1	4·572369
Slate Springs	282	14	11·5	102	25	50·3	4·444144
Paddy	38	32	05·1	218	20	53·4	4·625148

SLATE SPRINGS.

A triangulation station of the U. S. C. & G. S. on Shenandoah Mountain, 10 miles from Rawley Springs, Rockingham Co., Va.

Permanent mark: Marble block, 6 by 6 by 30 inches.

[Latitude, 38° 30′ 35″·71. Longitude, 79° 11′ 03″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Panther	102	25	50·30	282	14	11·50	4·4441440
Spruce	124	50	00·50	304	36	56·90	4·5678830
Green	152	26	11·80	332	16	28·70	4·6862700
North	220	20	17·10	40	34	29·30	4·7075440
Fork	272	40	51·08	93	09	32·89	4·8268669
Paddy	63	18	23·51	242	55	35·71	4·7776704

ROGERS (ELLIOTT KNOB).

A triangulation station of the U. S. C. & G. S. in Augusta Co., Va.

[Latitude, 38° 09′ 59″·36. Longitude, 79° 18′ 51″·30]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Fork	245	53	17·98	66	26	43·28	4·9338746
Humpback	303	25	22·43	123	40	43·46	4·6405399

PADDY.

A triangulation station of the U. S. C. & G. S. on Alleghany range, at the corner of Bath and Highland counties, Va., and Pocahontas Co., W. Va.

Permanent mark: Marble block 6 by 6 by 30 inches.

[Latitude, 38° 15′ 56″·77. Longitude, 79° 47′ 46″·29.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
State Springs	242	55	35·71	63	18	23·51	4·7776704
Panther	218	20	53·40	38	32	05·10	4·6251480
Bald Knob	7	19	03·00	187	17	00·60	4·5803674

HOLMES.

A triangulation station of the U. S. C. & G. S. in Kanawha Co., W. V It is on the ridge dividing the waters flowing into Cooper Cree and thence into Elk River, and those by Two Mile Creek into the Kanawha River. Station on land owned by Mr. S. W. Gibson, is about 8 miles from Charleston and about one-half mile northeast of Holme house.

Permanent mark: A bottle set in cement, and over this a stone bloc 6 by 6 by 30 inches. The top of the block is marked U. S. C. S. Fou blocks, each 6 by 6 by 30 inches, placed north, south, east, and west North block is 6·94 feet from center, south block 6·60 feet, east bloc 6·95 feet, west block 6·69 feet.

[Latitude, 38° 25′ 40″·87. Longitude, 81° 35′ 34″·31.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Table Rock........	4	07	37·3	184	06	48·4	4·4258038
Elk................	17	54	57·0	197	54	06·0	3·8120110
Creed..............	311	56	47·0	131	58	01·0	3·5886000

SUMMERSVILLE.

A triangulation station of the U. S. C. & G. S. in Nicholas Co., W. Va. Station is on a ridge 1 mile from Nicholas C. H. belfry and bearing 6° north of west. A large tree left standing is visible for 40 miles. A spike is driven into this tree, and station bears 354° 40′, distant 15·4 feet from this spike. Nearest railroad station is Kanawha Falls, on Chesapeake and Ohio Railroad, 32 miles distant.

Permanent mark: Bottle set into a hole with sandstone block placed over it, 6 by 6 by 30 inches, and cross cut on top. Reference marks, four sandstone blocks set north, south, east, and west, with arrow cut on top pointing to center. Distance, north block, 7·02 feet; south block, 7 feet; east block, 7·29 feet; west block, 6·90 feet.

[Latitude, 38° 16′ 55″·42. Longitude, 80° 52′ 07″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Beech..............	309	07	25·1	129	17	18·8	4·4741174
Ivy................	45	04	22·9	224	41	22·4	4·8889444

BEECH.

A triangulation station of the U. S. C. & G. S. Station on Beech knob about 4 miles north of Mr. Albert G. Williams's house in Greenbrier Co., W. Va., and 11 miles northeast of Snow Hill post-office. Station on the highest part of Beech knob.

Permanent mark: A rough sandstone block 24 by 6 by 6 inches, with four other similar blocks north, south, east, and west. Distance from center to north block, 6·90 feet; to south block, 6·98 feet; to east block, 6·81 feet; to west block, 7·09 feet.

[Latitude, 38° 06′ 44″·63. Longitude, 80° 36′ 18″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Briery	261	06	01·7	81	15	41·1	4·3641965
Keeney	13	11	44·6	193	08	03·1	4·5868151
Summersville	129	17	18·8	309	07	25·1	4·4741174

BRIERY.

A triangulation station of the U. S. C. & G. S. in Pocahontas Co., W. Va., on the divide between Greenbrier and Gauley rivers. The station is on a knob about 4 miles west of Hillsboro, at the headwaters of Spring Creek. It is at the eastern end of knob about 50 yards west of a bunch of live pines.

Permanent mark: Copper bolt in solid rock, with cross on top, above which is placed a marble slab 6 by 6 by 30 inches, top marked U. S. C. S. North, iron bolt in rock, 7·02 feet distance; south, iron bolt in rock, 7·06 feet; east, marble block, 6·98 feet; west, marble block, 7·02 feet.

[Latitude, 38° 08′ 39″·65. Longitude, 80° 20′ 40″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Knob	299	06	43·0	119	24	57·1	4·6958141
Keeney	37	43	22·1	217	30	03·3	4·7155703
Beech	81	15	41·1	261	06	01·7	4·3641965

TABLE ROCK.

A triangulation station of the U. S. C. & G. S. in Kanawha Co., W. Va. Station on the range of hills lying between the two forks of Lens Creek, which flows into the Kanawha River at Brownstown, and is near the headwaters of the creek, about 7 miles from Brownstown station, on a long, very narrow, and steep ridge, cleared of trees.

Permanent mark: A small bottle set in cement 30 inches below surface, and on top is a sandstone block 6 by 6 by 30 inches, top marked U. S. C. S. Four other blocks are placed north, south, east, and west, with tops cut with cross and arrows pointing to center. North block 30 inches long; distance, 7·01 feet. South block 30 inches long; distance, 6·97 feet. East block 30 inches long; distance, 7·05 feet. West block 30 inches long; distance, 6.98 feet.

[Latitude, 38° 11′ 18″·56. Longitude, 81° 36′ 53″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ivy	346	14	43·2	166	19	17·1	4·6607764
Holmes	184	06	48·4	4	07	37·3	4·4258038
Creed	191	18	19·0	11	20	22·0	4·3886600

MOUNT STERLING.

Station on old Fort Hill, on edge of town of Mount Sterling, Montgomery Co., Ky. Summit cleared of timber.

Permanent mark: Tripod with tin cone.

[Latitude, 38° 03′ 28″·4. Longitude, 83° 55′ 50″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Coburn	308	06	18	128	13	46	4·35341
Pilot	1	16	15	181	16	06	4·20986

HUMPBACK.

A triangulation station of the U. S. C. & G. S. on boundary between Augusta and Nelson counties, Va.

[Latitude, 37° 56′ 55″·91. Longitude, 78° 53′ 57″·24.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Peters	249	45	46·02	70	08	25·64	4·7579991
Fork...............	215	34	15·22	35	52	11·46	4·8603035
Spear	344	20	09·02	164	25	09·40	4·6492787

BALD KNOB.

A triangulation station of the U. S. C. & G. S., in Bath Co., Va., on Warm Springs Mountain, about 3 miles (air line) south of Healing Springs, 1,000 feet north of highest summit, and 20 feet lower. Millboro depot and Covington, nearest railroad stations.

Permanent mark: Copper bolt in large flat rock.

[Latitude, 37° 55′ 32″·64. Longitude, 79° 51′ 04″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Paddy.............	187	17	00·6	7	19	03·0	4·5803674
Flat Top...........	335	40	48·5	155	50	39·8	4·760975
Potts	35	49	53·1	215	39	03·8	4·647675
Keeney............	77	36	00·0	257	04	33·3	4·8866970
Briery	119	24	57·1	299	06	43·0	4·6958141

PAINT.

Sharp knob near Paint Creek, Fayette Co., W. Va.

Permanent mark: Lone tree.

[Latitude, 37° 56′ 50″·8. Longitude, 81° 18′ 28″·8.]

KEENEY.

A triangulation station of the U. S. C. & G. S. in Summers Co., W. Va., on highest part of Keeney Mountain, 8 miles by road and trail northwest of Alderson, W. Va.

Permanent mark: Marble block 6 by 6 by 30 inches.

[Latitude, 37° 46′ 24″·92. Longitude, 80° 42′ 19″·11.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Knob	257	04	33·3	77	36	00·0	4·6806970
Potts	291	03	48·1	111	24	19·4	4·723811
Salt Pond	342	26	41·9	162	32	50·0	4·692562
Buckhorn	24	34	15·4	204	24	12·9	4·768306
Beech	193	08	03·1	13	11	44·6	4·5868151
Briery	217	30	03·3	37	43	22·1	4·7155703

DRY MOUNTAIN.

On a small hill in Campbell Co., Va., about 200 feet above surrounding country, 13 miles from Brook Neal. Summit flat and timbered, with exception of small clearing. Instrument mounted on scaffold 35 feet high.

Permanent mark: Pine tree.

[Latitude, 37° 06′ 22″·90. Longitude, 79° 03′ 47″·99.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Johnson	109	54	13	289	43	24	4·450035
Long Top	174	21	08	354	20	18	4·313741
Brushy	65	44	01	245	34	27	4·412498

LONG TOP.

A triangulation station of the U. S. C. &. G. S., in Campbell Co., Va.

[Latitude, 37° 17′ 27″·65. Longitude, 79° 05′ 10″·24.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dry Mountain	354	20	18·00	174	21	08·00	4·313741
Johnson	65	59	05·00	245	49	04·00	4·428030
Smith	54	21	55·00	234	04	32·17	4·7203317
Brushy	34	40	48·00	214	32	02·00	4·578031

BAKER.

On a wooded hill but little higher than the surrounding country in southwestern part of Prince Edward Co., Va., about 6 miles south of

Pamplin City, on Norfolk and Western Railroad. Lanes were cut fr signal tree toward Leigh, Willis, Spear, and Long stations.

Permanent mark: A tall pine.

[Latitude, 37° 12′ 09″·57. Longitude, 78° 38′ 39″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Long Top	104	10	23·00	283	54	20·00	4·606598
Spear	165	15	37·00	345	11	18·00	4·615267
Willis	207	52	51·00	27	59	23·00	4·530945
Leigh	269	35	25·27	89	45	45·83	4·403301

LEIGH.

On a hill about 150 feet high, about 6 miles northwest of Burkevill (the crossing of the Norfolk and Western and Richmond and Danvill railroads), and 8 miles southwest of Farmville, Prince Edward Co., V Timber cut from summit.

Permanent mark: A tall leaning pine.

[Latitude, 37° 12′ 14″·21. Longitude, 78° 21′ 32″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baker	89	45	45·83	269	35	25·27	4·403301
Willis	162	37	59·22	342	34	08·68	4·495407

WILLIS.

On a hill in eastern part of Buckingham Co., Va. Summit bare and rocky. Altitude above the surrounding country about 900 feet.

Permanent mark: Bolt in solid rock.

[Latitude, 37° 28′ 22″·76. Longitude, 78° 27′ 52″·93.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baker	27	59	23·00	207	52	51·00	4·530945
Spear	110	36	46·00	290	25	52·00	4·449553
Leigh	342	34	08·68	162	37	59·22	4·495407

SPEAR.

A triangulation station of the U. S. C. & G. S. in Buckingham Co., Va.

[Latitude, 37° 33′ 42″·91. Longitude, 78° 45′ 46″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Humpback	164	25	09·40	344	20	09·02	4·6492787
Peters	213	41	29·41	33	59	02·17	4·8770536
Willis	290	25	52·00	110	36	46·00	4·449553
Baker	345	11	18·00	165	15	37·00	4·615267

TOBACCO ROW.

A triangulation station of the U. S. C. & G. S., in Amherst Co., Va.

[Latitude, 37° 33′ 55″·76. Longitude, 79° 11′ 26″·17.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spear	270	28	12·87	90	43	51·43	4·5778224
Humpback	211	01	08·58	31	11	50·86	4·6963346

FLAT TOP.

A triangulation station of the U. S. C. & G. S.. on line between Botetourt and Bedford counties, Va., 10 miles northwest of Liberty, Bedford Co., Va. Rough wagon road to within one-fourth of a mile of station.

Permanent mark: Marble block, 6 by 6 by 30 inches.

[Latitude, 37° 27′ 06″·85. Longitude, 79° 34′ 58″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Potts	108	32	37·90	288	12	03·40	4·719626
Bald Knob	155	50	39·80	335	40	48·50	4·760975
Smith	358	12	27·78	178	13	04·97	4·6865204
Cahas	46	04	20·04	225	48	36·09	4·7276606

POTTS.

On line between Craig and Alleghany counties, Va. On a rounded knob on Potts Mountain east of Fincastle and Sweet Springs, 12 miles by road and trail north of Newcastle, Craig Co.

Permanent mark: Rock cairn.

[Latitude, 37° 36′ 02″·9. Longitude, 80° 08′ 45″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Keeney	111	24	19·4	291	03	48·1	4·723811
Bald Knob	215	39	03·8	35	49	53·1	4·647675
Flat Top	288	12	03·4	108	32	37·9	4·719626
Salt Pond	51	22	13·4	231	07	55·8	4·647707
Cahas	347	50	23·3	167	55	07·5	4·739539
Streets	4	53	56·7	184	52	14·1	4·688312

JOHNSON.

On boundary between Bedford and Campbell counties, Va., 7 miles from Lynch Station on Virginia Midland Railroad. Summit sharp and about 600 feet above surrounding country. Timber cut down.

Permanent mark: Lone tree.

[Latitude, 37° 11′ 32″·78. Longitude, 79° 21′ 42″·56.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Smith	42	35	34	222	28	11	4·428534
Long Top	245	49	04	65	59	05	4·428030
Dry Mountain	289	43	24	109	54	13	4·450035

BRUSHY.

Sharp peak on big ridge in Pittsylvania Co., Va., 2 miles from Sycamore Station, Virginia Midland Railroad. Timber cut down.

Permanent mark: Lone tree.

[Latitude, 37° 00′ 37″·16. Longitude, 79° 19′ 41″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Smith	91	16	15	271	07	40	4·325442
Long Top	214	32	02	34	40	48	4·578031
Dry Mountain	245	34	27	65	44	01	4·412498

SMITH.

A triangulation station of the U. S. C. & G. S., in Pittsylvania Co., Va.

[Latitude, 37° 00′ 51″·53. Longitude, 79° 33′ 56″·93.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Flat Top	178	13	04·97	358	12	27·78	4·6865204
Long Top	234	04	32·17	54	21	55·00	4·7203317
Johnson	222	28	11·00	42	35	34·00	4·428534
Brushy	271	07	40·00	96	16	15·00	4·325442

WASEOTO.

In Letcher Co., Ky., near Virginia and Kentucky State line, at the junction of Black and Cumberland mountains, at the head of Poor Fork of Cumberland and Pond Fork of Big Sandy, 7 miles east of Whitesburg, Letcher Co., Ky.

Permanent mark: Chestnut tree.

[Latitude, 37° 08′ 44″·8. Longitude, 82° 43′ 54″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Quicksand	157	01	47·9	336	54	36·3	4·651632
Frazier	189	57	17·2	9	59	35·4	4·511800
Willard	242	01	51·2	62	14	29·2	4·543945
Big Butt	275	55	06·5	96	20	17·5	4·794159
High Knob	339	31	42·5	159	35	23·9	4·415766

CARR.

Not occupied. Situated in Perry Co., Ky., at head of Stacy Branch of Carr Fork of Kentucky River, about 7 miles from its mouth.

Permanent mark: Medium sized pine tree trimmed up.

[Latitude, 37° 14′ 29″·2. Longitude, 83° 05′ 33″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Long Spur	352	18	06	172	19	56	4·529005
Harlan	27	47	28	207	39	20	4·633374

WILLARD.

On Pine Mountain on the line between Dickinson Co., Va., and Pike Co., Ky., 4 miles west of "the Breaks" of Russell Fork of Sandy River, and south-southeast of Fish Trap post-office.

Permanent mark: Two small trees.

[Latitude, 37° 15′ 35″·3. Longitude, 82° 22′ 59″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Frazier	121	52	25·4	301	42	03·4	4·472873
Wolf	162	08	53·3	342	01	58·8	4·735622
Waseoto	62	14	29·2	242	01	51·2	4·543945

FRAZIER.

In Floyd Co., Ky., on end of spur, near head of Mud and Frazier creeks, ten miles (air line) southwest of Pikeville, Ky.

Permanent mark: Tall hickory tree.

[Latitude, 37° 24′ 02″·9. Longitude, 82° 40′ 05″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Quicksand	111	54	23·0	291	44	51·1	4·396315
Preston	152	23	43·8	332	14	31·1	4·679871
Wolf	193	09	13·7	13	12	43·8	4·569316
Willard	301	42	03·4	121	52	25·4	4·472873
Waseoto	9	59	35·4	189	57	17·2	4·511800

QUICKSAND.

On line between Floyd and Knott counties, Ky., at the head of Licking River. Nearest town is Hindman, in Knott Co.

Permanent mark: Large pine tree.

[Latitude, 37° 29′ 03″·3. Longitude, 82° 55′ 46″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Preston	181	27	41·1	1	28	02·2	4·520126
Waseoto	336	54	36·3	157	01	47·9	4·651632
Frazier	291	44	51·1	111	54	23·0	4·396315

HOGTOWN.

On divide between Quicksand and Licking rivers on line between Magoffin and Breathitt counties, Ky.; 12 to 15 miles south of Salyersville. Summit cleared of timber.

Permanent mark: A chestnut oak, shaped like a pine.

[Latitude, 37° 37′ 01″·9. Longitude, 83° 04′ 28″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nailor	60	40	38	240	28	09	4·539677
Cope	92	09	43	272	00	57	4·325746

WOLF.

On sharp ridge at head of Wolf Creek, Martin Co., Ky., 12 miles (air line) southwest of Warfield on Tug Fork of Sandy River.

Permanent mark: Large chestnut tree.

[Latitude, 37° 43′ 34″·4. Longitude, 82° 34′ 20″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Castle	138	37	03·8	318	28	31·8	4·489071
Preston	101	39	08·3	281	26	22·5	4·494856
Frazier	13	12	43·8	193	09	13·7	4·569316
Willard	342	01	58·8	162	08	53·3	4·735622

PRESTON.

On northeast end of Long Knob at head of Barnett and Jennie and Little Paint creeks, in Johnson Co., Ky., 7 miles southwest of Paintsville.

[Latitude, 37° 46′ 57″·3. Longitude, 82° 55′ 11″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wolf	281	26	22·5	101	39	08·3	4·494856
Quicksand	1	28	02·2	181	27	41·1	4·520126
Frazier	332	14	31·1	152	23	43·8	4·679871

BEAR WALLOW.

On Sandy Ridge, near State boundary between McDowell Co., W. Va., and Buchanan and Tazewell counties, Va.

Permanent mark: Tall tree.

[Latitude, 37° 14′ 38″·6. Longitude, 81° 44′ 50″·2.]

DIAL ROCK.

On East River Mountain, 10 miles west of Graham, Tazewell Co., Va.; summit rounded, with timber mostly cut down.

Permanent mark: Rock cairn.

[Latitude, 37° 09′ 68″·4. Longitude, 81° 25′ 00″·3.]

BIG BEND.

On line between Wythe and Bland counties, Va., on Walker Mountain, east of Wythe and Tazewell road gap, 12 miles northwest of Wytheville, Va. Summit is barren and rocky. All timber cut down.

Permanent mark: Small dead tree on highest part.

[Latitude, 37° 01′ 37″·8. Longitude, 81° 10′ 56″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Draper	284	59	45·4	105	10	01·0	4·418229
Lookout	358	05	57·5	178	06	29·4	4·600876
Peak	270	35	37·3	90	51	17·9	4·586716
Morris	93	45	57·0	273	30	14·3	4·588357
Ripshin	37	36	57·5	217	30	32·1	4·415592

BUCKHORN.

At Doubles of East River Mountain, on State line between Giles Co., Va., and Mercer Co., W. Va. Oakvale, on New River branch of Norfolk and Western Railroad, is nearest railroad station; distant, 4 miles. Station on sharp rock, half way between tree trunks.

Permanent mark: Hole drilled in rock.

[Latitude, 37° 17′ 33″·5. Longitude, 80° 58′ 49″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Keeney	204	24	12·9	24	34	15·4	4·768306
Salt Pond	260	36	50·6	80	52	57·0	4·599484
Peak	325	24	28·0	145	32	52·3	4·560481

PILOT.

On line between Mercer and Wyoming counties, W. Va., on Flat Top Mountain, a few miles from Peters Gap, Permanent mark: Stump on highest point.

[Latitude, 37° 29′ 04″·3. Longitude, 81° 16′ 18″·8.]

BURNING ROCK.

On Huff Mountain, 4 miles west of Oceana, Wyoming Co., W. Va.

Permanent mark: Lone tree.

[Latitude, 37° 41′ 38″·0. Longitude, 81° 41′ 51″·6.]

SALT POND.

On Salt Pond Mountain, one-fourth of a mile by trail above Mounta Lake Post-office and hotel, Giles Co., Va. Staytide is nearest railro station. Station is on highest part of flat ledge of rocks.

Permanent mark: Three holes drilled in rock, with arrows cut in ro pointing to center.

[Latitude, 37° 21′ 00″·8. Longitude, 80° 32′ 15″·3.]

To station.	Azimuth.			Back azimuth,			Log. dist.
	°	′	″	°	′	″	*Meters.*
Keeney	162	32	50·0	342	26	41·9	4·692562
Potts	231	07	55·8	51	22	13·4	4·647707
Streets	304	06	24·2	124	18	55·7	4·568130
Buffalo	355	00	55·7	175	03	06·1	4·790414
Buckhorn	80	52	57·0	260	36	50·6	4·599484
Peak	27	19	26·7	207	11	47·9	4·611519

STREETS.

In Montgomery Co., Va., Streets Entry, a part of Poore's Mountai on Blue Ridge, 5 miles south of Big Springs Depot, Va., by good trai

Permanent mark: Large oak tree.

[Latitude, 37° 09′ 46″·1. Longitude, 80° 11′ 33″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Potts	184	52	14·1	4	53	56·7	4·688312
Cahas	287	47	07·7	107	53	32·4	4·218064
Buffalo	32	00	56·7	211	50	40·0	4·680703
Salt Pond	124	18	55·7	304	06	24·2	4·568130
Peak	72	42	25·2	252	22	18·7	4·714273

CAHAS.

A triangulation station of the U. S. C. & G. S., in Franklin Co., Va Rocky Mount is the nearest railroad station on south, and Salem and Roanoke nearest ones on north.

Permanent mark: Marble block 6 by 6 by 30 inches.

[Latitude, 37° 07′ 01″·95. Longitude, 80° 00′ 56″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Potts	167	55	07·5	347	50	23·3	4·739539
Flat Top (C. & G. S.)	225	48	36·09	46	04	20·04	4·7276606
Streets	107	53	32·4	287	47	07·7	4·218064
Turkey Cock	314	14	55·0	134	27	50·0	4·649021

BIG BUTT.

On Sandy Ridge, between Russell and Buchanan counties, Va.

Permanent mark: Tall tree.

[Latitude, 37° 03′ 09″·2. Longitude, 82° 02′ 08″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Morris	270	25	33·5	90	40	41·1	4·570827
Red Rock	305	13	51·9	125	22	07·9	4·398428
Waseoto	96	20	17·5	275	55	06·5	4·794159
High Knob	71	36	52·2	251	15	26·3	4·746547
Clinch	8	58	16·1	188	56	41·1	4·3[illegible]9896

MORRIS.

In Tazewell Co., Va., on Morris Knob, about 10 miles from Tazewell, Va. Summit level for some distance, and cleared of large timber.

Permanent mark: Rock cairn.

[Latitude, 37° 02′ 57″·5. Longitude, 81° 37′ 01″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Bend	273	30	14·3	93	45	57·0	4·588357
Ripshin	315	13	20·5	135	22	35·7	4·511802
Red Rock	50	05	22·9	229	58	33·5	4·341566

PEAK.

In Pulaski Co., Va., on Peak Creek Knob, 3 miles southeast of Pulaski City, on Norfolk and Western Railroad.

Permanent mark: Long-leafed pine on edge of cliff, with blaze on southeast side of foot.

[Latitude, 37° 01′ 22″·0. Longitude, 80° 44′ 54″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Draper	64	39	03·3	244	33	38·9	4·168954
Big Bend	90	51	17·9	270	35	37·3	4·586716
Buckhorn	145	32	52·3	325	24	28·0	4·560481
Salt Pond	207	11	47·9	27	19	26·7	4·611519
Streets	252	22	18·7	72	42	25·2	4·714273
Buffalo	316	04	45·7	136	14	31·5	4·542365

STONE QUARRY.

In Estill Co., Ky., 7 miles south of Irvine; west of station Camp Creek. Summit cleared on north side. Lanes cut through timber on other sides.

Permanent mark: Oak tree, east of summit.

[Latitude, 37° 37′ 56″·2. Longitude, 84° 02′ 33″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot (2)	196	57	38	17	01	35	4·51120
High Rocks	233	14	05	53	23	50	4·46560
Richmond	118	10	05	298	00	37	4·411876

BEAR.

In Madison Co., Ky., 5 miles east of Berea, on Louisville and Nashville Railroad. Wagon road within 300 yards of station; all timber cut down.

Permanent mark: Chestnut oak stump, 5 feet high.

[Latitude, 37° 32′ 08″·9. Longitude, 84° 15′ 21″·3.]

To stations.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Richmond	170	11	41·0	350	10	03·0	4·365480
Pilot (2)	214	02	34·0	34	14	21·0	4·702669
Lancaster	108	09	36·0	287	57	47·0	4·477008
Brushy	34	47	27·0	214	41	04·0	4·34232

LANCASTER.

Station on top of court-house, Lancaster, Garrard Co., Ky.

Permanent mark: Center of cupola.

[Latitude, 37° 37′ 10″·5. Longitude, 84° 34′ 43″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Richmond	240	58	15	61	08	27	4·447482
Bear	287	57	47	108	09	36	4·477008
Sand	66	48	27	246	37	49	4·446153
Brushy	337	29	52	157	35	16	4·534383

SAND.

In Casey Co., Ky., near corner of Casey, Lincoln, and Boyle counties, 6 miles southwest of Junction City. Wagon road to station. Summit cleared of timber.

Permanent mark: Charred stump of tree, 15 feet high.

[Latitude, 37° 31′ 12″·4. Longitude, 84° 52′ 08″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lancaster	246	37	49	66	48	27	4·446153
Brushy	297	49	39	118	05	38	4·642653
Green River	356	59	50	177	00	42	4·609318

BRUSHY.

In Rockcastle Co., Ky., at head of Brushy Creek, 7 miles southwest of Mount Vernon, Rockcastle Co. Summit cleared of timber.

Permanent mark: Tripod of saplings.

[Latitude, 37° 20′ 04″·5. Longitude, 84° 25′ 51″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lancaster	157	35	16	337	29	52	4·534383
Bear	214	41	04	34	47	27	4·434232
Sand	118	05	38	297	49	39	4·642653
Green River	61	32	39	241	17	36	4·621760

GREEN RIVER.

Not occupied. In Casey Co., Ky., near Pulaski Co. line, 15 miles west of Somerset. Houses near by. Summit cleared on south side, field full of dead trees on north side.

Permanent mark: Lone dead tree.

[Latitude, 37° 09′ 14″·9. Longitude, 84° 50′ 42″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sand	177	00	42	356	59	50	4·609318
Brushy	241	17	36	61	32	39	4·621760

RICHMOND.

In Madison Co., Ky. Station on main building of Richmond University. Instrument set on chimney and angles reduced to flagstaff. Connection made with astronomical station U. S. C. & G. S.

Permanent mark: Flagstaff.

[Latitude, 37° 44′ 30″·4. Longitude, 84° 18′ 02″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot (2)	239	30	48	59	44	16	4·572089
Stone Quarry	298	00	37	118	10	05	4·411876
Bear	350	10	03	170	11	41	4·365480
Lancaster	61	08	27	240	58	15	4·447482

WILLOUGHBY.

In Montgomery Co., Ky., 10 miles south of Mount Sterling. Station on the north side of summit in a field full of dead trees; south side entirely cleared. Mr. Willoughby lives about one-half mile from the summit.

Permanent mark: Small oak tree.

[Latitude, 37° 55′ 39″·8. Longitude, 83° 53′ 07″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ballard	272	19	44	92	26	20	4·19743
High Rocks	328	02	21	148	06	21	4·25704

RACCOON.

In Laurel Co., Ky., 6 or 7 miles east of London. Lafayette McDaniel lives near station. Summit cleared of timber.

Permanent mark: A dead chestnut tree.

[Latitude, 37° 09′ 04″·3. Longitude, 83° 59′ 29″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
King	15	07	57	195	04	18	4·539352
Paint Gap	302	32	21	122	46	11	4·606811
High Knob	217	32	55	37	36	20	4·137989
Hunter	216	38	35	36	46	33	4·512155
Pilot (1)	242	59	12	63	04	52	4·193329
Orchard	272	10	32	92	19	50	4·358185

ORCHARD.

Station in peach orchard belonging to Gen. Garrard, 4 miles from Manchester, Clay Co., Ky. Summit entirely cleared.

Permanent mark: Scaffold 40 feet high.

[Latitude, 37° 08′ 35″·2. Longitude, 83° 44′ 05″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Paint Gap	331	44	57	151	49	31	4·375560
Raccoon	92	19	50	272	10	32	4·358185
Pilot (1)	131	58	16	311	54	38	4·076677

PILOT (1).

At head of Rudder Creek, Clay Co., Ky., 8 miles northwest of Manchester. All timber cut down except three small trees, middle one of which is the signal.

Permanent mark: Small tree.

[Latitude, 37° 12′ 53″·8. Longitude, 83° 50′ 05″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Orchard	311	54	38	131	58	16	4·076677
Raccoon	63	04	52	242	59	12	4·193329
Rice	231	06	12	51	15	01	4·440279
High Knob	124	37	12	304	34	57	3·826928
Hunter	196	14	54	16	17	10	4·296360

PILOT (2).

Three miles north of Clay, Powell Co., Ky., near head of Black Creek.

[Latitude 37° 51′ 42″·68. Longitude, 83° 56′ 05″·64.]

To station	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Richmond	59	44	16	239	30	48	....
Stone Quarry	17	01	35	196	57	38	4·511200
Bear	34	14	21	214	02	34	4·702669
Mount Sterling	181	16	06	1	16	15	4·209860

HIGH KNOB.

Near corner of Jackson, Owsley, Clay, and Laurel counties, Ky., near head of Sexton Creek, 14 miles northwest of Manchester Summit. Cleared of timber.

Permanent mark: Oak tree.

[Latitude, 37° 14′ 57″·6. Longitude, 83° 53′ 49″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Raccoon	37	36	20·0	217	32	55·0	4·137969
Pilot	304	34	57·0	124	37	12·0	3·826928

HUNTER.

At head of Island Creek, Owsley Co., Ky., three-fourths of a mile north of Island Creek Knob, 15 miles southwest of Booneville Summit, cleared.

Permanent mark: White oak tree.

[Latitude. 37° 23′ 10″·0. Longitude, 83° 46′ 20″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Pilot (1)	16	17	10	196	14	54	4·296360
Raccoon	36	46	33	216	38	35	4·512155
Gross	229	27	41	49	34	15	4·321085
Rose	246	37	16	66	45	12	4·322187
Rice	276	06	10	96	12	42	4·204182

RICE.

On divide at head of Indian and Buffalo creeks, in Owsley Co., Ky. Is best reached from Booneville by road up Indian Creek. Wagon road runs within 1 mile of station. Summit partly cleared.

Permanent mark: Scaffold built on eight white oak trees.

[Latitude, 37° 22′ 14″·3. Longitude, 83° 35′ 33″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot (1)	51	15	01	231	06	12	4·440279
Hunter	96	12	42	276	06	10	4·204182
Gross	180	07	54	00	07	55	4·185112

TURKEY.

Near head of Buck Creek, 5 miles southwest of Booneville, Owsle Co., Ky. Summit not cleared on the west side. Wagon road to M Brandenburg's, one-half mile from summit.

Permanent mark: A slender hickory tree.

[Latitude, 37° 27′ 16″·3. Longitude, 83° 44′ 26″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gross	245	20	58	65	26	23	4·159544
Rose	267	25	41	87	32	29	4·217351

ROSE.

On line between Owsley and Breathitt counties, Ky. On divid between Meadow and Turkey creeks, 9 miles east of Booneville Wagon road runs one-half mile north of station. John Terry lives 1½ miles east of station. Observations were made from a 20-foot platform

Permanent mark: A chestnut oak tree.

[Latitude, 37°, 27′, 39″·7. Longitude, 83°, 33′, 16″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hunter	66	45	12	246	37	16	4·322187
Gross	147	41	30	327	40	07	3·796433
Nailor	268	32	58	88	38	01	4·088108
Turkey	87	32	29	267	25	41	4·217351

NAILOR.

In Breathitt Co., Ky., at head of Cane Creek and Canoe Fork, 9 miles south of Jackson. A high bare rock. Roger Spicer lives one-half mile from station on Canoe Fork.

Permanent mark: A scrubby chestnut tree.

[Latitude, 37° 27′ 49″·5. Longitude, 83° 24′ 58″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rose	88	38	01	268	32	58	4·088108
Gross	107	47	46	287	51	20	4·213942
Nelson	162	29	08	342	25	24	4·475289
High Rocks	138	44	18	318	31	05	4·682865
Hogtown	240	28	09	60	40	38	4·530877
Cope	206	49	01	26	52	45	4·300015

GROSS.

At head of north fork of Meadow Creek, on line between Owsley and Breathitt counties, Ky., 8 miles northeast of Boonville. Col. Wm. Wilson lives near station. Not cleared on highest summit. Clearing 100 yards southwest and 40 feet lower than highest summit.

Permanent mark: Chestnut oak.

[Latitude, 37° 30′ 31″·1. Longitude, 83° 35′ 32″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rice	00	07	55	180	07	54	4·185112
Hunter	49	34	15	229	27	41	4·321085
Cope	242	22	44	62	32	55	4·442788
Nailor	287	41	20	107	47	46	4·213942
Rose	327	40	07	147	41	30	3·796433
Turkey	65	26	23	245	20	58	4·159544

COPE.

At head of Frozen Creek, branch of Cope's Fork, in Breathitt Co., Ky. Capt. Cope lives 2 miles from station. Summit cleared except on north side.

Permanent mark: Hickory tree.

[Latitude, 37° 37′ 26″·9. Longitude, 83° 18′ 51″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nailor	26	52	45	206	49	01	4·300015
Gross	62	32	55	242	22	44	4·442788
Nelson	120	45	31	300	38	02	4·320641
High Rocks	114	21	47	294	04	46	4·650713
Hogtown	272	00	57	92	09	43	4·325746

NELSON.

Two miles southeast of Campton, Wolf Co., Ky., on divide between Stillwater, Swift Camp, and Upper Devil creeks. Summit cleared on south and west ends. Instrument on 45-foot scaffold.

[Latitude, 37° 43′ 13″·4. Longitude, 83° 31′ 05″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cope	300	38	02	120	45	31	4·320641
Nailor	342	25	24	162	29	08	4·475289
Ballard	143	29	24	323	22	28	4·444551

HIGH ROCKS.

In Powell Co., Ky., near Estill Co. line, 4 miles east of Estill furnace. Summit a bare rock.

Permanent mark: Pine tree trimmed up.

[Latitude, 37° 47′ 22″·3. Longitude, 83° 46′ 36″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cope	294	04	46	114	21	47	4·650713
Nailor	318	31	05	138	44	18	4·682865
Ballard	202	51	47	22	54	23	4·20244
Coburn	194	54	31	14	56	17	4·21478
Willoughby	148	06	21	328	02	21	4·25704
Stone Quarry	53	23	50	233	14	05	4·46560

BALLARD.

In Menifee Co., Ky., on west end of Ballard Knob. Dick Powel (guide) lives 1½ miles southeast of Rothwell Station, on coal road Instrument on 25-foot platform.

Permanent mark: 25-foot stump.

[Latitude, 37° 55′ 18″·4. Longitude, 83° 42′ 23″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nelson	323	23	28	143	29	24	4·444551
High Rocks	22	54	23	202	51	47	4·20244
Coburn	120	28	25	300	27	35	3·35970
Willoughby	92	26	20	272	19	44	4·19743

COBURN.

Two miles south of Rothwell Station on coal railroad, Menifee Co., Ky. Dick Powell (guide) lives at foot. Timber all cut down.

Permanent mark: Large pine tree trimmed up.

[Latitude 37° 55′ 56″·2. Longitude 83° 43′ 43″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ballard	300	27	35	120	28	25	3·35970
High Rocks	14	56	17	194	54	31	4·21478
Mount Sterling	128	13	46	308	06	18	4·35841

SHORT.

In Hawkins Co., Tenn. On highest part of Short Mountain, 16 miles northeast of Morristown, Tenn. Summit is flat, requiring much chopping.

Permanent mark: Large oak tree standing alone on highest part.

[Latitude, 36° 22′ 52″·6. Longitude, 83° 10′ 45″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
House	60	39	14·1	240	18	24·1	4·782893
McLean	98	44	41·8	278	17	58·2	4·832847
White Rock	142	24	47·5	322	15	05·7	4·599886
War Gap	224	59	04·6	45	04	29·9	4·285132
Chucky	329	08	24·4	149	18	28·7	4·698762
English	11	20	20·8	191	16	09·7	4·734850

WAR GAP.

In Hawkins Co., Tenn., on Clinch Mountain, one-fourth of a mile west of gap of same name. There is a wagon road to within one-fourth of a mile of station; the remaining distance has to be traversed on foot. Rogersville, Tenn., 11 miles distant, is nearest railroad station.

Permanent mark: Small cedar tree.

[Latitude, 36° 30′ 14″·7. Longitude, 83° 01′ 38″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
White Rock	115	22	11·1	295	07	01·9	4·622433
Short	45	04	29·9	224	59	04·6	4·285132
Grays Knob	143	16	41·0	323	07	15·0	4·594655

DRAPER.

In Wythe Co., Va., on knob at west end of Draper Mountain, 12 miles by road and trail east of Wytheville, Va. Summit cleared.

Permanent mark: Tall chestnut left standing on summit.

[Latitude, 36° 57′ 56″·7. Longitude, 80° 53′ 53″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Buffalo	296	31	07·1	116	46	16·1	4·622859
Rich	351	25	20·7	171	27	57·3	4·639612
Lookout	36	06	02·8	215	56	21·7	4·611367

CLINCH.

On Clinch Mountain, north of Little Moccasin Gap and 13 miles northwest of Abingdon, Va., on county line between Russell and Washington counties, Va. Summit nearly level for one-eighth of a mile.

Permanent mark: Large sugar maple tree.

[Latitude, 36° 49′ 44″·5. Longitude, 82° 04′ 46″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Butt	188	56	41·1	8	58	16·1	4·399896
Red Rock	246	55	06·6	67	04	57·1	4·422822
Holston	359	44	24·8	179	44	29·3	4·615067
High Knob	98	20	19·3	278	00	31·5	4·695063

RED ROCK.

In Smyth Co., Va., 5 miles northwest of Saltville. This town, on branch of Norfolk and Western Railroad, is the nearest railroad station.

Permanent mark: Dead tree on northern edge of summit.

[Latitude, 36° 55′ 20″·0. Longitude, 81° 48′ 22″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meter.*
Morris	229	58	33·5	50	05	22·9	4·341566
Ripshin	282	37	16·0	102	53	18·8	4·609925
Rogers	321	13	35·1	141	22	58·1	4·571462
Clinch	67	04	57·1	246	55	06·6	4·422822

RIPSHIN.

In Smyth Co., Va., on Ripshin Mountain, east of Marion, Va. Su
mit a long, wooded ridge. Much timber still standing back from sig

Permanent mark: Oak tree on east end of ridge.

[Latitude, 36° 50′ 28″·3. Longitude, 81° 21′ 37″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Bend	217	30	32·1	37	36	57·5	4·415592
Lookout	318	04	45·4	138	11	41·1	4·411971
Rogers	39	23	32·0	219	16	54·6	4·414834
Red Rock	102	53	18·8	282	37	16·0	4·609925

BUFFALO.

A triangulation station of the U. S. C. & G. S. in Floyd Co., Va., o
a rocky ridge, about 150 yards long, with no trees on the top. Thi
ridge has two rocky elevations, one at the west end and the other a
the east end of the ridge. The station is at the west end.

Permanent mark: Copper bolt driven into the solid rock.

[Latitude, 36° 47′ 46″·26. Longitude, 80° 28′ 39″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Moore (C. & G. S.)	338	26	35·5	158	33	32·7	4·6763536
Rich	52	05	47·1	231	53	18·6	4·596347
Draper	116	46	16·1	296	31	07·1	4·622859
Poore	36	25	06·9	216	00	55·1	5·0132543

LOOKOUT.

In Grayson Co., Va., 3 miles by road and trail north of Independence, Va., and 28 miles south of Wytheville, Va. Station on bluff of western summit. Top is nearly level and heavily timbered.

Permanent mark: Oak tree.

[Latitude, 36° 40′ 04″·5. Longitude, 81° 10′ 03″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rich	288	07	25·3	108	19	39·8	4·507986
Bullhead	339	46	04·1	159	49	40·0	4·416687
Draper	215	56	21·7	36	06	02·8	4·611367
Ripshin	138	11	41·1	318	04	45·4	4·411971
Negro	42	09	07·5	221	58	33·2	4·597278
Rogers	88	37	51·8	268	24	20·4	4·528367

ROGERS.

On Mount Rogers, Balsam Mountains, Grayson Co., Va. Marion, Va., is nearest railroad station, 25 miles distant. Summit is very flat and covered with balsam timber, through which lines of sight were cut to other stations.

Permanent mark: Balsam tree on highest part.

[Latitude, 36° 39′ 36″·1. Longitude, 81° 32′ 42″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ripshin	219	16	54·6	39	23	32·0	4·414834
Lookout	268	24	20·4	88	37	51·8	4·528367
Negro	345	36	45·9	165	39	40·6	4·468604
Red Rock	141	22	58·1	321	13	35·1	4·571462
Snake	21	49	15·4	201	43	26·8	4·594754

WHITE TOP.

On mountain of same name, near corner of Washington, Smyth, and Grayson counties, Va. Marion, 25 miles distant, is the nearest railroad station. The summit is very flat and covered with balsam timber.

Permanent mark: Lone tree on edge of cliff on eastern end of summit.

[Latitude, 36° 38′ 21″·76. Longitude, 81° 36′ 12″·48.]

MOORE.

A triangulation station of the U. S. C. & G. S., on Moore Knob, 7 miles by road and trail west of Danbury, Stokes Co., N. C.

[Latitude, 36° 23′ 53″·60. Longitude, 80° 16′ 59″·24.]

Station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Young	24	13	35·34	204	00	42·94	4·9049408
Buffalo	158	33	32·74	338	26	35·52	4·6763536
Rich	112	22	41·40	292	03	20·20	4·7201740
Bullhead	94	38	57·10	274	11	01·80	4·8481660
Poore	63	50	32·92	243	19	34·44	4·9430262

TURKEY COCK.

Sixteen miles west of Chatham and near Calland, near county line of Franklin, Henry, and Pittsylvania counties, Va. Summit cleared of timber.

Permanent mark: A lone chestnut oak.

[Latitude, 36° 50′ 11″·19. Longitude, 79° 39′ 28″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cahas	134	27	50	314	14	55	4·649021
Smith	202	31	56	22	35	15	4·329907
White Oak	303	10	14	123	18	33	4·392873

WHITE OAK.

Nine miles south of Chatham, 7 miles northwest of Danville, in Pittsylvania Co., Va. Summit cleared on north end. Mr. Johnson lives on summit.

Permanent mark: Chestnut oak tree.

[Latitude, 36° 42′ 51″·8. Longitude, 79° 25′ 34″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Turkey Cock	123	18	33	303	10	14	4·392873
Smith	159	33	18	339	28	17	4·550606

RICH.

On Blue Ridge 12 miles north of Fisher Peak, in Patrick Co., Va. Summit flat and timbered.

Permanent mark: Oak tree.

[Latitude, 36° 34′ 37·6. Longitude, 80° 49′ 31″·9.]

To station.	Azimuth.			Black azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Buffalo	231	53	18·6	52	05	47·1	4·506347
Moore	292	03	20·2	112	22	41·4	4·720174
Draper	171	27	57·3	351	25	20·7	4·639612
Lookout	108	19	39·8	288	07	25·3	4·507986
Bullhead	56	21	41·2	236	13	04·3	4·414766

BULLHEAD.

On Blue Ridge on the boundary between Alleghany and Wilkes counties, N. C., a few miles southeast of Sparta.

Permanent mark: A few small trees standing together.

[Latitude, 36° 26′ 49″·7. Longitude, 81° 04′ 00″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rich	236	13	04·3	56	21	41·2	4·414766
Moore	274	11	01·8	94	38	57·1	4·848166
Lookout	159	49	40·0	339	46	04·1	4·416687
Negro	82	18	58·2	262	04	50·3	4·555147
Poore	10	19	40·6	190	16	29·3	4·654910

NEGRO.

Two miles south of Jefferson, Ashe Co., N. C. There is a trail part way up the mountain, but last half mile is very steep and rocky and must be walked.

Permanent mark: Small tree on highest point.

[Latitude, 36° 24′ 11″·6. Longitude, 81° 27′ 48″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rogers	165	30	40·6	345	36	45·9	4·468604
Lookout	221	58	33·2	42	09	07·5	4·597278
Bullhead	262	04	50·3	82	18	58·2	4·555147
Snake	69	57	38·3	249	48	56·8	4·368287
Poore	325	02	01·2	145	12	53·9	4·683388

SNAKE.

Station is in Watauga Co., N. C., very near Tennessee line. Abingdon, Va., is perhaps the most convenient railroad station, but is about 45 miles distant. Summit is a long, barren, rocky ridge. A guide and accommodations can be had at Lionsville, at the head of Cove Creek, 5 miles from station.

Permanent mark: Hole drilled in rock.

[Latitude, 36° 19′ 51″·1. Longitude, 81° 42′ 28″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rogers	201	43	26·8	21	49	15·4	4·594754
Negro	249	48	56·8	69	57	38·3	4·368287
Poore	302	38	29·7	122	38	01·1	4·769059
Grandfather	20	45	23·1	200	41	45·2	4·115328
Roan	56	09	16·3	235	54	34·5	4·652679
Holston	113	05	39·5	292	52	30·3	4·556433

HOLSTON.

In Carter and Sullivan counties, Tenn., on range of same name, 16 miles by road southeast of Bristol, Tenn.

Permanent mark: Large oak tree.

[Latitude, 36° 27′ 27″·3. Longitude, 82° 04′ 38″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
High Knob	134	31	23·4	314	11	36·2	4·839025
Clinch	179	44	29·3	359	44	24·8	4·615067
Snake	292	52	30·3	113	05	39·5	4·556433
Roan	5	54	31·1	185	52	55·2	4·595299
Chimney Top	84	57	09·8	264	14	44·2	4·753608

HIGH KNOB.

On Powell Mountain, at the head of Stony Creek, and on the line between Scott and Wise counties, Va., 22 miles north of Gate City.

Permanent mark: Lone tree.

[Latitude, 36° 53′ 33″·0. Longitude, 82° 37′ 46″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Butt	251	15	26·3	71	36	52·2	4·746547
Clinch	278	00	31·5	98	20	19·3	4·695063
Chimney Top	7	20	44·0	187	17	57·9	4·734033
Holston	314	11	36·2	134	31	23·4	4·839025

LONG SPUR.

In Harlan Co., Ky., on Black Mountain, near the mouth of Clover Lick Creek, branch of Poor Fork of the Cumberland River.

Permanent mark: Large bushy oak 2½ feet in diameter.

[Latitude, 36° 56′ 22″·4. Longitude, 83° 02′ 30″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gray	52	53	11	232	44	14	4·444875
Paint Gap	92	03	39	271	43	12	4·703587
Harlan	79	35	10	259	25	14	4·397712

GRAY.

In Harlan Co., Ky., on Little Black Mountain, 6 miles by road south of Harlan. Knob is sharp and top is well cleared.

Permanent mark: Double oak tree.

[Latitude, 36° 47′ 16″·2. Longitude, 83° 17′ 26″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
War Gap	323	07	15	143	16	41	4·594655
White Rocks	46	29	55	226	24	10	4·295628
Long Spur	232	44	14	52	53	11	4·444875
Harlan	168	57	46	348	56	48	4·097454
Paint Gap	123	12	27	303	01	00	4·529809

HARLAN.

In Harlan Co., Ky., on Pine Mountain, 3 miles north of the town of Harlan. Trail from Harlan to Hazard passes near station.

Permanent mark: White oak 2 feet in diameter.

[Latitude 36° 53′ 54″·7. Longitude 83° 19′ 03″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Long Spur	259	25	14	79	35	10	4·397712
Gray	348	56	48	168	57	46	4·097454

PAINT GAP.

At the head of Goose Creek, branch of South Fork of Kentucky River and Stinking Creek, of Cumberland River. On boundary between Clay and Knox counties, Ky., 20 miles by road north-northeast of Pineville. Knob is well cleared.

Permanent mark: Large oak tree to northwest of summit.

[Latitude, 36° 57′ 16″·5. Longitude, 83° 36′ 31″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gray	303	01	00	123	12	27	4·529809
White Rocks	336	15	36	156	21	17	4·544900
Long Spur	271	43	12	92	03	39	4·703587

M^{c}LEAN.

In Claiborne Co., Tenn., on Cumberland Mountain, 20 miles southwest of Cumberland Gap. Caryville, Tenn., on Kanawha and Ohio Railroad, is the nearest railroad station, distant 20 miles.

Permanent mark: Dead chestnut tree, 80 feet north of cliff.

[Latitude, 36° 28′ 19″·8. Longitude, 83° 55′ 47″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
House	339	48	23·4	159	54	11·3	4·629180
White Rocks	243	18	36·3	63	35	43·5	4·680563
Short	278	17	58·2	98	44	41·8	4·832847
King	160	52	57·0	340	47	07·0	4·647229
Cross	41	48	22·1	221	37	39·3	4·609123

WHITE ROCKS.

In Lee Co., Va., and Harlan Co., Ky., on Cumberland Mountain, 12 miles northeast of Cumberland Gap, and on the Kentucky and Virginia State line.

Permanent mark: Lone, dead, chestnut tree.

[Latitude, 36° 39′ 54″·7. Longitude, 83° 27′ 03″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
McLean	63	35	43·5	243	18	36·3	4·680563
War Gap	295	07	01·9	115	22	11·1	4·622433
Short	322	15	05·7	142	24	47·5	4·599886
Gray	226	24	10·0	46	29	55·0	4·295623
Paint Gap	156	21	17·0	336	15	36·0	4·544900
King	109	52	31·0	289	29	28·0	4·784457

KING.

In Whitley Co., Ky., 2 miles from Brummett Station, on Louisvi and Nashville Railroad. Summit cleared of timber.

Permanent mark: Hickory tree.

[Latitude, 36° 50′ 59″·9. Longitude, 84° 05′ 34″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
White Rocks	289	29	28	109	52	31	4·784457
McLean	340	47	07	160	52	57	4·647229
Paint Gap	254	47	58	75	05	24	4·650120

ROAN.

On the summit of Roan Mountain in Mitchell Co., N. C., and Cart Co., Tenn., on State line. Reached from Roan Mountain statio on East Tennessee and Western North Carolina Railroad, by regul stage line in summer, distant 12 miles. Station locally known "High Knob."

Permanent mark: "B" cut in rock on highest point.

[Latitude, 36° 06′ 16″·4. Longitude, 82° 07′ 20″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mitchell	18	54	52·4	198	49	50·8	4·600175
Big Bald	69	06	27·5	248	53	28·2	4·550354
Chimney Top	122	50	21·7	302	29	37·7	4·795078
Holston	185	52	55·2	5	54	31·1	4·595299
Snake	235	54	34·5	56	09	16·3	4·652679
Table Rock	317	36	15·2	137	44	41·6	4·505777
Grandfather	268	19	43·8	88	30	46·0	4·448944

CHIMNEY TOP.

In Sullivan, Greene, and Hawkins counties, Tenn., on a spur o Bays Mountain, 16 miles northwest of Jonesboro, Tenn. A road an trail lead to eastern end of summit; the rest of the distance is ver steep and rocky, and can not be ridden over.

Permanent mark : Pine tree just below summit.

[Latitude, 36° 24′ 28″·9. Longitude, 82° 42′ 24″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
High Knob	187	17	57·9	7	20	44·0	4·734033
Holston	264	14	44·2	84	37	09·8	4·753608
Big Bald	337	10	27·8	157	18	08·1	4·701716
Roan	302	29	37·7	122	50	21·7	4·795078

CROSS.

In Campbell and Anderson counties, Tenn., on Cross Mountain, 6 miles from Coal Creek station, on the Knoxville and Ohio Railroad. Summit is flat, bald in center, but heavily timbered around the edge.

Permanent mark: Large oak tree, from which lines of sight were cut out.

[Latitude, 36° 11′ 55″·2. Longitude, 84° 13′ 52″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
McLean	221	37	39·3	41	48	22·1	4·609123
House	282	49	46·2	103	06	12·9	4·632455
Melton	11	45	21·6	191	42	45·0	4·515224

HOUSE.

In Knox Co., Tenn., on House Mountain, 12 miles by road northeast of Knoxville, Tenn. Summit is sparsely timbered with pine; timber near the station has been cut down.

Permanent mark: Bolt in rock, set by the U. S. C. & G. S.

[Latitude, 36° 06′ 42″·9. Longitude, 83° 45′ 59″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
English	298	47	11·1	119	03	43·7	4·684020
Chilhowee (1)	358	53	11·2	178	53	28·7	4·585295
Melton	65	20	59·9	245	02	00·1	4·728210
McLean	159	54	11·3	339	48	23·4	4·629186
Short	240	18	24·1	60	39	14·1	4·782893
Cross	103	06	12·9	282	49	46·2	4·632455

POORE.

A triangulation station of the U. S. C. & G. S. in Alexander and Wilkes counties, N. C., on Poore Knob, of Brushy Mountain, 9 miles south-southeast of Wilkesboro, N. C., and 35 miles northwest of Statesville, on railroad. Moravian Falls is a good place to stop, from which there is a road and trail to station, a distance of 5 miles.

Permanent mark: Marble block 6 by 6 by 30 inches.

[Latitude, 36° 02′ 47″·66. Longitude, 81° 09′ 24″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Negro	145	12	53·9	325	02	01·2	4·683388
Bull Head	190	16	29·3	10	19	40·6	4·654910
Buffalo	216	00	56·17	36	25	06·97	5·0132543
Moore	243	19	34·44	63	50	32·92	4·9430262
Young	306	34	59·21	126	52	53·88	4·7586426
Benn	40	35	53·13	220	18	12·26	4·8461656
Snake	122	38	01·1	302	18	29·70	4·769059
Grandfather	97	10	24·1	276	47	18·6	4·773093

GRANDFATHER.

This station is the highest point anywhere on the Blue Ridge, being nearly 6,000 feet high. It is at the corner of Caldwell, Watauga, and

Mitchell counties, N. C.* The nearest railroad stations are Lenoir southeast and Cranberry to the northwest. The last 1,500 feet of asc is very difficult and can not be made on horseback.

Permanent mark: A balsam tree.

[Latitude, 36° 06′ 41″·5. Longitude, 81° 48′ 36″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Roan	88	30	46·0	268	19	43·8	4·448944
Snake	200	41	45·2	20	45	23·1	4·415328
Poore	276	47	18·6	97	10	24·1	4·773093
Benn	347	21	59·0	167	27	14·8	4·793092
Table Rock	15	02	31·7	194	59	57·6	4·403691
Hibriten	308	02	44·3	128	14	02·7	4·565110

TABLE ROCK.

In Burke Co., N. C. This station is on a lofty spur of the Bl Ridge. It can be reached from Morganton, N. C., by good road, miles. The last 600 feet is very steep and rocky and must be walke

Permanent mark: Cross cut in rock on highest part.

[Latitude, 35° 53′ 27″·7. Longitude, 81° 52′ 59″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mitchell	68	02	55·9	247	49	30·8	4·571149
Roan	137	44	41·6	317	36	15·2	4·505777
Grandfather	194	59	57·6	15	02	31·7	4·403691
Benn	330	48	04·5	150	55	52·5	4·616723

HIBRITEN.

In Caldwell Co., N. C. This station is on Brushy Mountain, a fe miles east of Lenoir.

Permanent mark: A large hickory tree near southwest end of sum mit.

[Latitude, 35° 54′ 25″·4. Longitude, 81° 29′ 22″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Benn	22	13	11·4	202	07	12·3	4·612200
Grandfather	128	14	02·7	308	02	44·3	4·565110

YOUNG.

A triangulation station of the U. S. C. & G. S. in Rowan Co., N.

[Latitude, 35° 44′ 14″·49. Longitude, 80° 38′ 51″·17.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′		*Meters.*
Poore	126	52	53·88	306	34	59·21	·7586426
Moore	204	00	42·94	24	13	35·34	4·9049408

BENN.

A station of the U. S. C. & G. S. in Cleveland, Burke Co., N. C., on South Mountain, 18 miles south of Morganton.

Permanent mark: A marble block 6 by 6 by 30 inches with U. S. C. S. cut on top.

[Latitude, 35° 33′ 55″·06. Longitude, 81° 39′ 37″·56.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hogback	52	44	45·02	232	22	51·79	4·8581240
Mitchell	112	11	53·80	291	50	44·60	4·7713100
Table Rock	150	55	52·50	330	48	04·50	4·6167230
Grandfather	167	27	14·80	347	21	59·00	4·7930920
Poore	220	18	12·26	40	35	53·13	4·8461656
Wofford	20	28	12·08	200	18	41·01	4·8559012
Hibriten	202	07	12·30	22	13	11·40	4·6122000
King	321	21	36·22	141	33	41·23	4·7051366

KING.

A triangulation station of the U. S. C. & G. S. in Gaston Co., N. C.

[Latitude, 35° 12′ 27″·87. Longitude, 81° 18′ 45″·59.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Benn	141	33	41·23	321	21	36·22	4·7051366
Young	225	34	52·15	45	58	01·68	4·9255300

ENGLISH.

In Jefferson and Cocke counties, Tenn. On highest part of English Mountain, 10 miles southwest of Newport, Tenn. Mountain is flat and nearly level for a long distance. It is heavily wooded and is not a good station.

Permanent mark: A tall oak tree, from which lines of sights were cut in the directions of the other stations.

[Latitude, 35° 54′ 04″·9. Longitude, 83° 17′ 51″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chilhowee (1)	70	10	49·9	249	54	38·9	4·646266
House	119	03	43·7	298	47	11·1	4·684020
Short	191	16	09·7	11	20	20·8	4·734850
Chucky	254	01	41·9	74	15	52·6	4·576996

CHUCKY.

In Greene Co., Tenn., on an outlying range of bald mountains, 15 miles south-southeast of Greenville, Tenn.

Permanent mark: Small tree just below summit.

[Latitude, 35° 59′ 39″·5. Longitude, 82° 53′ 42″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
English	74	15	52·6	254	01	41·9	4·576996
Short	149	18	28·7	329	08	24·4	4·698762

BIG BALD.

On State line, at the corner of Unicoi Co., Tenn., and Madison and Yancey counties, N. C. Jonesboro, Tenn., is nearest railroad station. No trees on summit and no permanent mark.

[Latitude, 35° 59′ 23″·5. Longitude, 82° 29′ 25″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chimney Top	157	18	08·1	337	10	27·8	4·701716
Sandymush	45	54	47·0	225	40	57·8	4·695401
Mitchell	320	46	10·4	140	54	05·4	4·507746
Roan	248	53	28·2	69	06	27·5	4·550354

MITCHELL.

In Yancey Co., N. C. The highest summit of Black Mountain and the highest peak east of the Rocky Mountains. The nearest railroad station is Black Mountain station on Western North Carolina Railroad. From there a road and trail lead to the summit, 18 miles distant. Very little timber obstructs the view from this station.

No permanent mark.

[Latitude, 35° 45′ 53″·6. Longitude, 82° 15′ 54″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hogback	2	01	02·1	182	00	08·8	4·819174
Pisgah	49	57	35·4	229	40	25·1	4·765870
Sandymush	80	26	09·2	260	04	20·0	4·754281
Big Bald	140	54	05·4	320	46	10·4	4·507746
Benn	291	50	44·6	112	11	53·8	4·771310
Table Rock	247	49	30·8	68	02	55·9	4·571149
Roan	198	49	50·8	18	54	52·4	4·600175

BALSAM.

In Jackson and Haywood counties, N. C., on Balsam Mountain, 12 miles by road and trail south of Waynesville, N. C. Horses can be ridden to within 2 miles of the summit, but the remaining distance must be walked on account of fallen timber.

Permanent mark: Lone balsam tree.

[Latitude, 35° 22′ 02″·1. Longitude, 82° 59′ 24″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sandymush	195	36	18·2	15	40	00·9	4·554261
Pisgah	252	55	22·4	73	03	29·0	4·345752
Rabun	32	24	58·9	212	14	17·1	4·722187
Pinnacle	328	29	12·1	148	37	47·9	4·637371
Cowee	82	10	14·9	261	58	14·6	4·501722

PISGAH.

In the southwest corner of Buncombe and Haywood counties, N. C. It is best reached from Asheville. Summit is very sharp and rocky. The instrument was set on the highest point and no signal was used or permanent mark left.

[Latitude, 35° 25′ 32″·5. Longitude, 82° 45′ 24″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sandymush	157	42	50·3	337	38	24·7	4·481298
Mitchell	220	40	25·1	40	57	35·4	4·765870
Balsam	73	03	29·0	252	55	22·4	4·345752
Pinnacle	358	10	37·2	178	11	08·7	4·638736
Hogback	303	38	20·9	123	54	30·7	4·707685

SANDYMUSH.

In Buncombe, Haywood, and Madison counties, N. C., on Newfound range, distant 26½ miles from Asheville, N. C. There is a good road and trail from Thomas Ferguson's house, 3½ miles from station.

Permanent mark: Chestnut tree, trimmed.

[Latitude, 35° 40′ 41″·7. Longitude, 82° 53′ 01″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Bald	225	40	57·8	45	54	47·0	4·695401
Mitchell	260	04	20·0	80	26	00·2	4·754281
Pisgah	337	38	24·7	157	42	50·3	4·481298
Balsam	15	40	00·9	195	36	18·2	4·554261

THUNDERHEAD.

On the Great Smoky Mountains on the boundary between Swain Co., N. C., and Blount Co., Tenn. Bryson, N. C., is the nearest railroad station on the North Carolina side, and Marysville on the Tennessee side. The nearest settlement on the south side is Mr. Hall's, from which there is a good trail to station, 6 miles distant.

Permanent mark: Clump of laurel bushes on highest summit.

[Latitude, 35° 34′ 06″·8. Longitude, 83° 42′ 22″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chilhowee (2).....	96	31	53·6	276	21	22·0	4·439392
Chilhowee (1).....	167	48	44·2	347	46	54·8	4·348599
Cowee............	308	22	32·4	128	35	25·2	4·632765
Cheowah..........	355	04	54·3	175	05	47·5	4·432219
Christie Peak.....	49	46	32·3	229	37	22·3	4·495836

CHILHOWEE (2).

In Blount Co., Tenn., on Chilhowee range, 6 miles by road and trail southwest of Montvale Springs Hotel. Marysville, Tenn., is the nearest railroad station, 15 miles distant.

Permanent mark: Pine tree.

[Latitude, 35° 35′ 46″·9. Longitude, 84° 00′ 28″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Guide..............	49	59	05·4	229	51	11·6	4·429081
Roy Knob.........	78	45	33·6	258	30	15·7	4·607927
Melton............	142	21	38·5	322	11	13·1	4·642955
Thunderhead......	276	21	22·0	96	31	53·6	4·439392
Chilhowee (1).....	230	15	40·5	50	24	24·2	4·467369

CHILHOWEE (1).

In Blount Co., Tenn., on Chilhowee range, 1 mile southwest of Millstone Gap. Marysville, Tenn., is nearest railroad station, 16 miles distant.

Permanent mark: One chestnut and one hickory tree standing together.

[Latitude, 35° 45′ 54″·5. Longitude, 83° 45′ 30″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chilhowee (2)....	50	24	24·2	230	15	40·5	4·467369
Melton............	108	08	44·8	287	49	32·3	4·715486
House............	178	53	28·7	358	53	11·2	4·585295
English...........	249	54	38·9	70	10	49·9	4·646266
Thunderhead.....	347	46	54·8	167	48	44·2	4·348599

MELTON.

A triangulation station of the U. S. C. & G. S., Roane Co., Tenn. Nearest railroad station is Lenoir, about 12 miles distant. Summit is long, flat, and heavily timbered.

Permanent mark: Marble block 6 by 6 by 30 inches.

[Latitude, 35° 54′ 34″·8. Longitude, 84° 18′ 18″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cross	191	42	45·0	11	45	21·6	4·515224
House	245	02	00·1	65	20	59·9	4·728210
Chilhowee (1)	287	49	32·3	108	08	44·8	4·715486
Chilhowee (2)	322	11	13·1	142	21	38·5	4·642955
Roy Knob	16	40	03·5	196	35	07·0	4·649520
Hinch	77	01	58·5	256	38	18·7	4·795756

COWEE.

In Macon, Jackson, and Swain counties, N. C. This station is on Cowee Ridge, 9 miles west of Webster, N. C. House of James Buchanan, on Green Creek, 6 miles from Webster and 3 miles from the triangulation station, is a convenient stopping place.

Permanent mark: Small oak tree.

[Latitude, 35° 19′ 39″·9. Longitude, 83° 20′ 10″·0]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thomas Bald	29	36	26·3	209	29	27·5	4·571563
Cheowah	89	39	45·8	269	27	48·4	4·496065
Thunderhead	128	35	25·2	308	22	32·4	4·632765
Balsam	261	58	14·6	82	10	14·9	4·501722
Rabun	355	16	54·5	175	18	09·8	4·605596

HOGBACK.

A triangulation station of the U. S. C. & G. S. in Greenville Co., S. C. A summit of the Blue Ridge, 10 miles southeast of Saluda, N. C. This is a very flat mountain, but nearly all the timber has been cut.

Permanent mark: Marble block 6 by 6 by 30 inches.

[Latitude, 35° 10′ 12″·25. Longitude, 82° 17′ 26″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pinnacle	69	54	49·28	249	39	15·61	4·6416975
Pisgah	123	54	30·70	303	38	20·90	4·7076850
Paris	23	27	52·72	203	23	43·61	4·4415437
Benn	232	22	51·79	52	44	45·02	4·8581240
Mitchell	182	00	08·80	2	01	02·10	4·8197740

PINNACLE.

In Pickens Co., S. C., on a spur of the Blue Ridge. Greenville is the nearest railroad station.

Permanent mark: A marble block 6 by 6 by 30 inches, placed there by the U. S. C. & G. S.

[Latitude, 35° 02′ 00″·85. Longitude, 82° 44′ 30″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rabun	81	43	40·71	261	24	28·30	4·7118767
Balsam	148	87	47·90	328	29	12·10	4·6373710
Pisgah	178	11	08·70	358	10	37·20	4·6387360
Mauldin	337	23	21·00	157	27	01·39	4·4055863
Hogback	249	39	15·61	69	54	49·28	4·6416975

THOMAS BALD.

Also called Standing Indian Mountain, in Macon Co., N. C., and near the Georgia State line, at head of Nantahalah River, North Carolina, and Tallulah River, Georgia. Tallulah Falls, Ga., is nearest railroad station. Summit is a long, barren, rocky ridge.

Permanent mark: Rock cairn.

[Latitude, 35° 02′ 07″·3. Longitude, 83° 32′ 16″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blood	48	09	33·5	227	55	51·9	4·690619
Tusquittah	125	22	42·6	305	16	12·6	4·323497
Cheowah	158	02	57·7	337	58	01·6	4·540647
Rabun	289	33	19·3	109	41	31·1	4·363354
Cowee	209	29	27·5	29	36	26·3	4·571583

PACK.

On highest part of Pack Mountain, Cherokee Co., N. C., 21 miles west of Murphy by road and trail; easy of ascent.

Permanent mark: Two trees standing together.

[Latitude, 35° 03′ 00″·9. Longitude, 84° 17′ 10″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haw Knob	219	21	31·9	39	30	30·4	4·570086
Tusquittah	258	10	54·9	78	30	13·4	4·716895
Blood	317	05	02·1	137	17	61·1	4·671646
Cowpen	55	59	46·7	235	49	52·6	4·501706
Chilhowee (4)	104	59	45·6	284	48	12·3	4·499915

GRINDSTONE.

In James and Bradley counties, Tenn. On the Grindstone Mountains, 3 miles east of Ooltewah and 11 miles west of Cleveland, Tenn. Summit very flat, but mostly cleared.

Permanent mark: Tall oak tree.

[Latitude, 35° 04′ 18″·0. Longitude, 85° 01′ 18″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chilhowee (4)	260	56	17·0	81	10	06·4	4·568029
Rocky Face	7	19	24·1	177	19	53·1	4·439467
High Point	55	50	16·2	235	37	31·6	4·612271

TUSQUITTAH.

On highest part of Tusquittah Mountains, Clay Co., N. C. The Summit is nearly bald. It is reached from Valleytown by a good road and trail.

[Latitude, 35° 08′ 42″·5. Longitude, 83° 43′ 35″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haw Knob	123	48	43·8	303	38	20·8	4·516385
Cheowah	191	43	18·3	11	44	53·2	4·310650
Blood	23	13	14·0	203	05	59·8	4·689405
Thomas Bald	305	16	12·6	125	22	42·6	4·323497
Pack	78	30	18·4	258	10	54·9	4·716895

CHILHOWEE (4).

Knob at south end of Beans Mountain, Polk Co., Tenn., 6 miles by road and trail south-southeast of Benton, Tenn. Cleveland is nearest railroad station, 21 miles distant.

Permanent mark: Tall oak tree.

[Latitude, 35° 07′ 24″·7. Longitude, 84° 37′ 16″·2.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haw Knob	248	58	13·8	69	18	48·4	4·763014
Pack	284	48	12·3	104	59	45·6	4·490915
Cowpen	350	33	47·4	170	35	24·7	4·419569
Roy Knob	199	38	00·8	19	44	04·4	4·674199
Texas	130	26	56·9	310	16	55·7	4·538978
Grindstone	81	10	06·4	260	56	17·0	4·568029

TEXAS.

In Meigs Co., Tenn., highest of Texas Knobs, 14 miles by road north of Cleveland, Tenn. Summit wooded, but all obstructing timber has been cut down, except on east end.

Permanent mark: Chestnut tree.

[Latitude, 35° 19′ 31″·7. Longitude, 84° 54′ 38″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Harvey	102	06	36·1	281	53	13·7	4·553740
Hinch	173	04	49·4	353	02	27·3	4·707236
Roy Knob	242	15	06·1	62	31	15·8	4·677625
Chilhowee (4)	310	16	55·7	130	26	56·9	4·538978

HARVEY.

In Sequatchie Co., Tenn, on west side of Walden Ridge, between Henson and Alexander Gaps, near Raven Cliff. It can be reached from Dunlap, in the Sequatchie Valley, or from Rathburn (Soddy Iron Works) on the Cincinnati, New Orleans and Texas Pacific Railroad. It is the highest summit on ridge, and is flat and heavily timbered.

Permanent mark: Oak tree.

[Latitude, 35° 23′ 33″·1. Longitude, 85° 17′ 44″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hinch	213	35	13·2	33	46	17·8	4·714751
Texas	281	53	13·7	102	06	36·1	4·553740

HAW KNOB.

On the boundary line between Monroe Co., Tenn., and Graham Co., N. C. It can be reached from Murphy, N. C., by road and trail; distance 24 miles. Summit is flat and covered with huckleberry bushes 20 feet high.

Permanent mark: Clump of saplings on highest part.

[Latitude, 35° 18′ 34″·2. Longitude, 84° 01′ 35″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Christie Peak	211	23	38·1	31	25	36·8	3·997389
Tusquittah	303	38	20·8	123	48	43·8	4·516385
Cheowah	266	38	41·4	86	50	40·9	4·498134
Pack	39	30	30·4	219	21	31·9	4·570986
Chilhowee (4)	69	18	48·4	248	58	13·8	4·763014

CHRISTIE PEAK.

In Graham Co., N. C., about three miles from the Tennessee boundary. Can be reached by going up Little Santeetla Creek, thence by rough trail to station.

Permanent mark: Small clump of birch trees on highest part of summit.

[Latitude, 35° 23′ 09′·4. Longitude, 83° 58′ 10″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thunderhead	229	37	22·3	49	46	32·3	4·495836
Cheowah	284	13	47·3	104	23	48·7	4·432687
Haw Knob	31	25	36·8	211	23	38·1	3·907389

GUIDE.

Also known as Peaked Top, in Monroe Co.. Tenn. Sweetwater, Tenn., is the nearest railroad station, 22 miles distant. Madiscnville is 10 miles northwest.

Permanent mark: Dead chestnut tree.

[Latitude, 35° 26′ 25″·8. Longitude, 84° 14′ 03″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Roy Knob	115	52	38·8	295	45	16·1	4·329587
Chilhowee (2)	229	51	11·6	49	59	05·4	4·429081

ROY KNOB.

In Monroe Co., Tenn., on Roy Knob, 8 miles by road south of Sweetwater, Tenn.

Permanent mark: Large oak tree.

[Latitude, 35° 31′ 27″·6. Longitude, 84° 26′ 46″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Melton	196	35	07·0	16	40	03·5	4·649520
Chilhowee (4)	19	44	04·4	199	38	00·3	4·674199
Chilhowee (2)	258	30	15·7	78	45	33·6	4·607927
Guide	295	45	16·1	115	52	38·8	4·329587
Texas	62	31	15·3	242	15	06·1	4·677625

HINCH.

In Cumberland Co., Tenn. This station of the U. S. C. & G. S. is 12 miles northwest of Spring City, Tenn., and 3 miles west of Jewett, on Narrow Gauge Railroad. The summit is flat and wooded.

Permanent mark: U. S. C. & G. S. mark + in rock.

[Latitude, 35° 46′ 53″·1. Longitude, 84° 58′ 42″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Melton	256	38	18·7	77	01	58·5	4·795756
Texas	353	02	27·3	173	04	49·4	4·707236
Harvey	33	46	17·8	213	35	13·2	4·714751

CHEOWAH.

The highest summit of Cheowah Mountains, Graham Co., N. C. It is entirely bald. The railroad passes within a few miles of station.

Permanent mark: Rock cairn.

[Latitude, 35° 19′ 32″·2. Longitude, 83° 40′ 50″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haw Knob	86	50	40·9	266	38	41·4	4·498134
Christie Peak	104	23	48·7	284	13	47·3	4·432687
Thunderhead	175	05	47·5	355	04	54·3	4·432219
Cowee	269	27	48·4	89	39	45·8	4·496065
Thomas Bald	337	58	01·3	158	02	57·7	4·540647
Tusquittah	11	44	53·2	191	43	18·3	4·310650

WOFFORD.

Primary triangulation station of the U. S. C. & G. S. in Spartanb Co., S. C.

[Latitude, 34° 57′ 32″·31. Longitude, 81° 56′ 06″·73.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
King	243	53	48·85	64	15	17·00	4·8002103
Benn	200	18	41·01	20	28	12·08	4·8559012

PARIS.

A triangulation station of the U. S. C. & G. S. in Greenville Co., S.

[Latitude, 34° 56′ 29″·27. Longitude, 82° 24′ 40″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hogback	203	23	43·61	23	27	52·72	4·4415437
Wofford	267	18	17·75	87	34	39·25	4·6386551

MAULDIN.

A triangulation station of the U. S. C. & G. S. in Pickens Co., S.

[Latitude, 34° 49′ 18″·46. Longitude, 82° 38′ 05″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pinnacle	157	27	01·39	337	23	21·00	4·4055863
Paris	236	56	15·41	57	03	55·80	4·3869655

RABUN.

A triangulation station of the U. S. C. & G. S. on Blue Ridge, Rabu Co., Ga., at head of Little Tennessee River. The summit is shar rocky, and barren. Walhalla, S. C., is the nearest railroad station. Permanent mark of the U. S. C. & G. S. could not be identified.

[Latitude, 34° 57′ 55″·75. Longitude 83° 17′ 59″·27.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blood	66	55	55·20	246	34	04·20	4·8022677
Thomas Bald	109	41	31·10	289	33	19·30	4·363354
Cowee	175	18	09·80	355	16	54·50	4·605596
Balsam	212	14	17·10	32	24	58·90	4·722187
Currahee	8	13	04·00	188	10	27·80	4·6892851
Pinnacle	261	24	28·30	81	43	40·70	4·7118767

INDIAN.

A triangulation station of the U. S. C. & G. S. in Cherokee Co., Ala.

[Latitude, 34° 01′ 49″·94. Longitude, 85° 25′ 31″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lavender	201	16	30·8	21	21	07·6	4·5405243
Carnes	276	05	35·7	96	19	24·2	4·5823753

LAVENDER.

A triangulation station of the U. S. C & G. S. Station on highest peak of Lavender range, in Floyd Co., Ga., about 12 miles west of Rome. Permanent mark: Granite post.

[Latitude, 34° 19′ 19″·58. Longitude, 85° 17′ 18″·39.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Log	269	51	12·99	90	13	15·05	4·7777508
Carnes	325	09	30·87	145	18	45·80	4·6473879
Johns	207	33	58·84	27	40	28·35	4·5761765

PINE LOG.

A triangulation station of the U. S. C. & G. S. in Bartow Co., Ga.

[Latitude, 34° 19′ 18″·31. Longitude. 84° 38′ 13″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sawnee	282	00	16·00	102	16	21·90	4·6519200
Grassy	236	55	18·70	57	05	40·60	4·5252408
Johns	128	24	22·93	308	08	43·29	4·7321290

SWEAT.

A triangulation station of the U. S. C. & G. S. in Cobb Co., Ga.

[Latitude, 34° 04′ 01″·44. Longitude, 84° 27′ 21″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Log	149	27	57·15	329	21	50·66	4·5160840
Sawnee	235	15	58·91	55	25	55·50	4·5197394

SAWNEE.

A triangulation station of the U. S. C. & G. S. in Forsyth Co., Ga.

[Latitude, 34° 14′ 12″·12. Longitude, 84° 09′ 38″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Grassy	150	29	49·72	330	24	03·05	4·5027518
Skitt	233	23	19·17	53	38	10·60	4·7005389

GULF POINT.

A triangulation station of the U. S. C. & G. S. in Walker Co., Ga., Lookout Mountain, near "The Gulf," 33 miles by road and trail sou of Chattanooga, Tenn. Summit is flat except east of station. A large timber cut down.

Permanent mark: Marble block 6 by 6 by 30 inches of the U. S. & G. S.

[Latitude, 34° 37′ 32″·16. Longitude, 85° 28′ 02″·49.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
High Point	194	32	12·07	14	34	45·8	4·436212
Johns..............	270	21	38·30	90	34	13·30	4·5295379
Brandon	44	41	02·50	224	31	18·9	4·5731889
Gunter	84	36	45·60	264	12	44·6	4·812768

JOHNS.

A triangulation station of the U. S. C. & G. S. in Walker Co., Ga., mile south of north end of Johns Mountain, 21 miles south of Ringgol 3 miles south of Villanow.

Permanent mark: Marble block of U. S. C. & G. S., 6 by 6 by 3 inches.

[Latitude, 34° 37′ 23″·24. Longitude, 85° 05′ 53″·78.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gulf Point.........	90	34	13·30	270	21	38·30	4·5295879
High Point	134	50	00·20	314	39	56·70	4·578956
Rocky Face........	200	22	30·60	20	25	36·10	4·376078
Pine Log...........	308	08	43·29	128	24	22·93	4·7321290
Lavender	27	40	26·35	207	33	58·84	4·5761765

BRANDON.

A triangulation station of the U. S. C. & G. S. in DeKalb Co., Ala.

[Latitude, 34° 23′ 07″·34. Longitude, 85° 45′ 12″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Indian.............	322	21	48·3	142	32	52·6	4·6958379
Gulf Point	224	31	18·9	44	41	02·5	4·5731889

GUNTER.

A triangulation station of the U. S. C. & G. S. in Madison Co., Ala.

[Latitude, 34° 34′ 06″·83. Longitude, 86° 10′ 20″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gulf Point	264	12	44·6	84	36	45·6	4·812768
Aurora	1	16	13·0	181	15	50·1	4·670381

HIGH POINT.

A triangulation station of U. S. C. & G. S. in Walker Co., Ga., on Lookout Mountain, south of Nickajack Gap, 13 miles south-southwest of Chattanooga, Tenn. Summit is barren and rocky; all timber cut down.

Permanent mark: Hole drilled in rock, with arrow.

[Latitude, 34° 51′ 49″·8. Longitude, 85° 23′ 32″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Grindstone	235	37	31·60	55	50	16·20	4·612271
Rocky Face	277	03	05·20	97	16	16·20	4·549672
Gulf	14	34	45·80	194	32	12·07	4·436212
Johns	314	39	56·70	134	50	00·20	4·578966

ROCKY FACE.

A triangulation station of the U. S. C. & G. S. in Whitfield Co., Ga. t is a rounded knob on Rocky Face Mountain, 3 miles east of Tunnel Hill, Ga., and about 6 miles northwest of Dalton, Ga.

Permanent mark: Small lone tree.

[Latitude, 34° 49′ 26″·3. Longitude, 85° 00′ 28″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Grindstone	177	19	53·1	7	19	24·1	4·439467
Cowpen	259	26	13·3	79	41	05·8	4·605691
Johns	20	25	36·1	200	22	30·6	4·376078
High Point	97	16	16·2	277	03	05·2	4·549672

GRASSY.

A triangulation station of the U. S. C. & G. S. in Lumpkin Co., Ga.

[Latitude, 34° 29′ 10″·58. Longitude, 84° 19′ 53″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blood	232	01	29·60	52	14	56·10	4·6610442
Sawnee	330	24	03·05	150	29	49·72	4·5027518
Pine Log	57	05	40·69	236	55	18·70	4·5252408

SKITT.

A triangulation station of the U. S. C. & G. S. in Hall Co., Ga.

[Latitude, 34° 30′ 20″·56. Longitude, 83° 43′ 19″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blood	142	52	20·69	322	45	01·27	4·5131465
Currahee	265	12	57·37	85	24	43·72	4·5038010

CURRAHEE.

A triangulation station of the U. S. C. & G. S. in Habersham Co.,

[Latitude, 34° 31′ 45″·13. Longitude, 83° 22′ 33″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rabun	188	10	27·80	8	13	04·00	4·6892851
Mauldin	244	15	00·38	64	40	18·43	4·8767020

BLOOD.

A triangulation station of the U. S. C. & G. S. on Blue Ridge, Lumpkin and Union counties, Ga. Clarksville is nearest railro station. Summit barren and rocky.

Permanent mark: Copper bolt in solid rock.

[Latitude, 34° 44′ 23″·24. Longitude, 83° 56′ 13″·23.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Grassy	52	14	56·10	232	01	29·60	4·6610442
Cowpen	106	07	23·00	285	45	33·70	4·7825770
Pack	137	17	01·10	317	05	02·10	4·6716460
Tusquittah	203	05	59·80	23	13	14·00	4·6894050
Skitt	322	45	01·27	142	52	20·69	4·5131465
Rabun	246	34	04·20	66	55	35·20	4·8022677
Thomas Bald	227	55	51·90	48	09	33·50	4·6906190

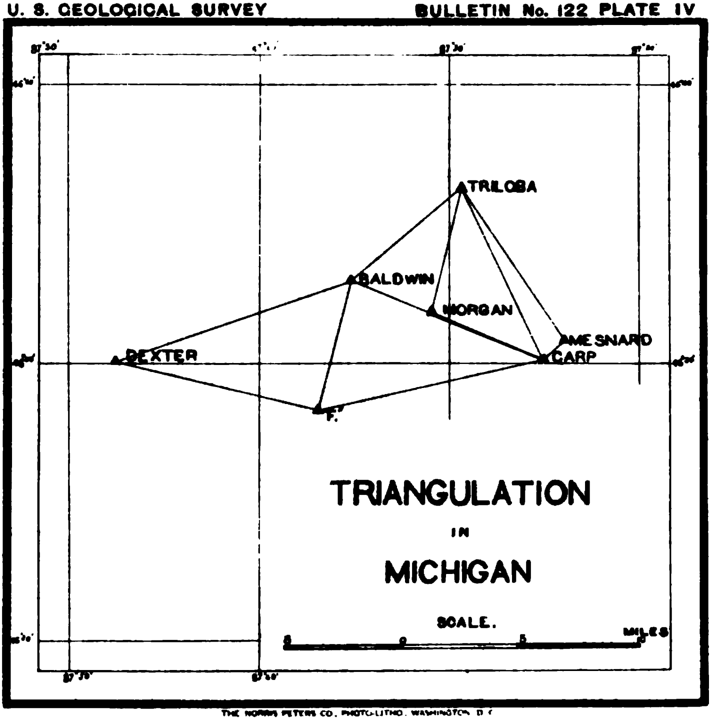
COWPEN.

Highest summit of Cohutta Mountain, Fannin Co., Ga., 7 miles trail from nearest road on south side. Summit flat and timbered north end.

Permanent mark: Rock cairn.

[Latitude, 34° 53′ 23″·5. Longitude, 84° 34′ 26″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chilhowee (4)	170	35	24·7	350	33	47·4	4·419569
Pack	235	49	52·6	55	59	46·7	4·501706
Blood	285	45	33·7	106	07	23·0	4·782577
Rocky Face	79	41	05·8	259	26	13·3	4·605691



TRIANGULATION IN MICHIGAN

SCALE.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

MICHIGAN.

METHODS OF WORK.

A narrow belt of triangulation was extended westward from Marquette in 1889. It rested upon two stations of the U. S. Lake Survey, Mesnard-Triloba. Angles were measured with a Schilling 6½-inch theodolite by F. J. Knight. Stations were selected on rocky knobs on either side of the railroad.

DESCRIPTIONS AND POSITIONS OF STATIONS.

MESNARD.

A U. S. Lake Survey station in Marquette Co., Mich., 2 miles south of Marquette. Height of ground at station is 522 feet above Lake Superior.

Permanent mark: A cross cut in solid rock, which is about 3 feet below surface soil.

[Latitude, 46° 30′ 48″·34. Longitude, 87° 23′ 59″·23.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Triloba	146	00	24·0	325	56	29·8	4·080203
Carp	47	50	48·0	227	50	00·0	3·28232

F.

Station on high, rocky knob, 3 miles southeast of Ishpeming, in Marquette Co., Mich., and 1½ miles northeast of the highest hill of the range.

Permanent mark: A cross cut in solid rock.

[Latitude, 46° 28′ 18″·28. Longitude, 87° 36′ 55″·47.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baldwin	195	12	54	15	14	14	3·95166
Carp	257	27	22	77	85	57	4·19038
Dexter	103	22	16	283	14	33	4·14590

BALDWIN.

On a granite ridge, about 4 miles north of Negaunee, in Marquett Co., Mich., one-half mile west of gap through which passed the ol charcoal tramway to Morgan Furnace.

Permanent mark: Cross cut on small, firm bowlder projecting a fe inches above ground.

[Latitude, 46° 32′ 57″·85. Longitude, 87° 35′ 05″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Triloba	229	46	13	49	50	22	3·98107
Carp	292	24	44	112	31	59	4·14069
Dexter	71	20	23	251	11	20	4·22661
F	15	14	14	195	12	54	3·95166

DEXTER.

On quartzite knob, south of the Dexter mine, one-half mile south c Golden Station, on Chicago and Northwestern Railroad, in Marquett Co., Mich., on highest point on north end of rock outcrop.

Permanent mark: Cross cut in solid rock.

[Latitude, 46° 30′ 02″·57. Longitude, 87° 47′ 33″·91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baldwin	251	11	20	71	20	23	4·22661
F	283	14	33	103	22	16	4·14590

CARP.

A wooded hill 3 miles southwest of Marquette; in Marquette Co. Mich. Part of timber has been cut down.

Permanent mark: A small evergreen tree on highest part.

[Latitude, 46° 30′ 06″·70. Longitude, 87° 25′ 05″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Morgan	112	51	46	292	47	32	3·90759
F	77	35	57	257	27	22	4·19038
Baldwin	112	31	59	292	24	44	4·14069
Mesnard	227	50	00	47	50	48	3·28232

MORGAN.

A steep hill about 1 mile north of old Morgan furnace, in Marquett Co., Mich. Station on high rock on south side of summit. Highest point not occupied because of a tree in line with Baldwin signal about half way between them.

Permanent mark: Cross cut in rock.

[Latitude, 46° 31′ 48″·26. Longitude, 87° 30′ 55″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Triloba	193	26	16	13	27	34	3·93258
Carp	292	47	32	112	51	46	3·90759

TRILOBA.

U. S. Lake Survey Station, 7 miles northwest of Marquette, on Mount Crissy, or Crispy, in Marquette Co., Mich. It is a bald granite knob about 3 miles southwest of Granite Point. Height of station above Lake Superior, 635 feet.

Permanent mark: A brass frustum leaded into the solid rock.

[Latitude, 46° 36′ 17″·94. Longitude, 87° 29′ 21″·83.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Carp	334	31	57·0	154	35	03·0	4·103610
Baldwin	49	50	22·0	229	46	13·0	3·981070
Morgan	13	27	34·0	193	26	16·0	3·932580
Mesnard	325	56	29·8	146	00	24·0	4·089203

ARKANSAS.

METHODS OF WORK.

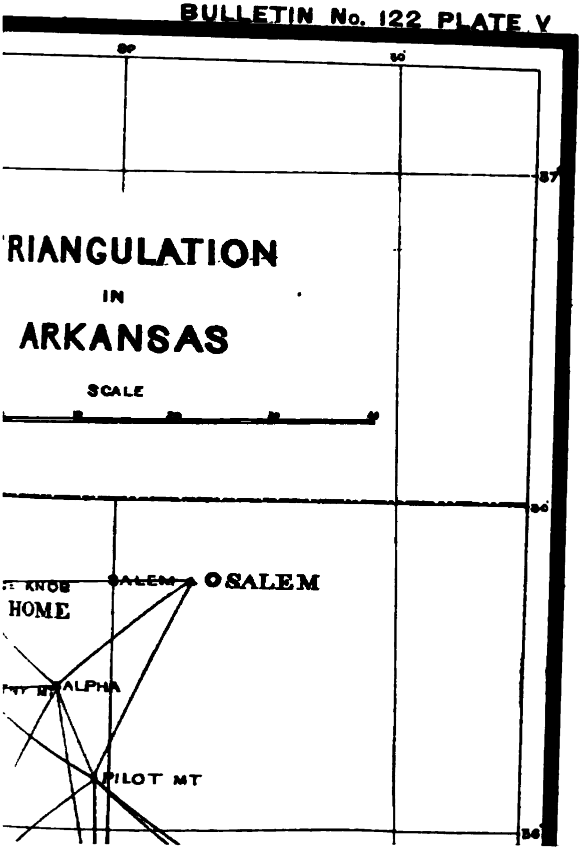
The triangulation in Arkansas starts from a base located just west of the State line in the Indian Territory and connected with the astronomical station of the U. S. Coast and Geodetic Survey at Fort Smith. It extends eastward along the thirty-fifth parallel of latitude to Little Rock, near which city a check base was measured. Difficulty was experienced in finding a favorable location for the initial base, but the site finally selected was in an open prairie bordered by several mountain ranges over 2,000 feet high, which furnished good points for expansion.

The initial base was measured at night with a 300-foot steel tape, on the roadbed of the St. Louis and San Francisco Railroad, beginning at Cameron, and was 2·84 miles in length. It was divided into sections of 1,200 feet, or 4 tape lengths, each section being measured three times. The tape was stretched under a tension of 20 pounds and the temperature noted at each tape length. A wye level was used to determine the relative elevations of stations. The base near Little Rock was measured twice on a cloudy day, its length being 3·72 miles. The azimuth of each base was determined by observations on Polaris near elongation.

The axial length of the belt of triangulation connecting the two bases is 135 miles; number of stations occupied, twenty-seven. This work was commenced in 1887 by S. S. Gannett, assisted by G. T. Hawkins, and finished in 1888. The angles at most of the stations were measured with a Fauth 7-inch (vernier) theodolite, but at the stations in the expansion of the Little Rock base a new Fauth 8-inch (micrometer) theodolite was used. The computation included a complete least square station and figure adjustment.

A belt of triangulation was extended during 1889, 1890, and 1891 from Fourche–Reynolds, stations of the initial belt near Morrillton, northward to Missouri; thence westward along the southern border of that State for about 60 miles; thence southward, joining the initial belt at the line Pinnacle–Sugarloaf, 20 miles southeast of Fort Smith. Angles at stations in this belt were measured with a Fauth 8-inch (micrometer) theodolite by George T. Hawkins. Azimuths were observed at intervals of about 50 miles.

Triangulation in this State was conducted generally in a manner similar to that pursued in the Appalachian Mountain region; that is, BULLETIN No. 122 PLATE V



rounded, wooded summits were selected as stations, cleared of timber, and one tree trimmed up and left as a signal and mark. In a few instances, where it was impracticable to cut off the timber, scaffolds were erected.

DESCRIPTIONS AND POSITIONS OF STATIONS.

CAVANAL.

High, flat mountain, 12 miles west of Cameron, in the Choctaw Nation, Ind. T. Station in tree top.

Permanent mark: Tree blazed near foot.

[Latitude, 35° 04′ 11″·43. Longitude, 94° 40′ 46″·16.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sugarloaf	284	18	30·16	104	25	46·09	4·297986
Peak	269	10	57·02	89	21	30·97	4·446473

NORTH BASE.

About 800 feet north of Cameron station, Choctaw Nation, Ind. T.

Permanent mark: Stone 6 by 6 by 30 inches set flush with surface of the ground.

[Latitude, 35° 07′ 59″·47. Longitude, 94° 32′ 01″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Peak	294	26	05·63	114	31	38·31	4·206813
Sugarloaf	333	34	24·91	153	36	39·60	4·125449

SOUTH BASE.

Two and one-half miles south of Cameron Station, Choctaw Nation, Ind. T., on St. Louis and San Francisco Railroad, 50 feet east of railroad.

Permanent mark: Stone 6 by 6 by 30 inches set flush with surface of ground.

[Latitude, 35° 05′ 47″·52. Longitude, 94° 33′ 23″·98.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sugarloaf	314	27	54·85	134	30	56·92	4·051474
Peak	278	47	20·48	98	53	40·54	4·229148

SUGARLOAF.

On Sugarloaf Mountain, 7 miles southeast of Cameron station, in th Choctaw Nation, Ind. T.; has all the timber cleared from summit.

Permanent mark: Lone tree with spikes.

[Latitude, 35° 01′ 31″·49. Longitude, 94° 28′ 07″·04.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Poteau (2)	309	38	29·34	129	41	41·88	4·043759
Peak	238	45	47·12	58	49	04·79	4·008536
Fort Smith	184	50	17·23	4	51	34·89	4·605344
Poteau (1)	10	18	45·54	190	17	59·02	4·060919
North Base	153	36	39·60	333	34	24·91	4·125449
South Base	134	30	56·92	314	27	54·85	4·051474
Cavanal	104	25	46·09	284	18	30·16	4·297986

FORT SMITH.

Sebastian Co., Ark. Station on top of Col. Leflore's house at south west corner of old fort about 50 feet from U. S. C. & G. S. astronomical station which was used as initial point by U. S. G. S.

Permanent mark: Stone monument.

[Latitude, 35° 23′ 14″·65. Longitude, 94° 25′ 52″·35.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Peak	351	20	45·80	171	22	46·66	4·547466
Sugarloaf	4	51	34·89	184	50	17·23	4·605344

POTEAU (1).

High mountain in Choctaw Nation, Ind T., 15 miles south of Cameron station on the St. Louis and San Francisco Railroad; has about 3 acres of timber chopped down; a good deal still standing on east and west ends.

Permanent mark: Lone oak tree.

[Latitude, 34° 55′ 24″·14. Longitude, 94° 29′ 28″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sugarloaf	190	17	59·02	10	18	45·54	4·060919
Poteau (2)	248	01	48·53	68	05	47·28	4·057047

POTEAU (2).

High round point on Poteau range, 2 miles south of Hartford, Sebastian Co., Ark.; has about 6 acres of timber cut down on top.

Permanent mark: Lone oak tree.

[Latitude, 34° 57′ 42″·39. Longitude, 94° 22′ 31″·33.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Peak	180	59	47·13	0	59	51·99	4·091545
East Poteau	265	28	50·94	85	36	18·68	4·298333
Sugarloaf	129	41	41·88	309	38	29·34	4·043759
Poteau (1)	68	05	47·28	248	01	48·53	4·057047
Black Fork	358	38	27·23	178	38	42·24	4·444388

BLACK FORK.

Hump on Black Fork range, on line between Scott and Polk counties, Ark., about 4 miles west of Eagle gap on the road between Waldron and Dallas.

Permanent mark: Lone tree.

[Latitude, 34° 42′ 39″·78. Longitude, 94° 22′ 05″·39.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Poteau	213	06	24·02	33	13	35·50	4·544975
Poteau (2)	178	38	42·24	358	38	27·23	4·444388

PEAK.

Sharp peak on Sugarloaf Mountain, about 25 miles south of Fort Smith, Sebastian Co., Ark.

Permanent mark: A pile of rocks.

[Latitude, 35° 04′ 22″·98. Longitude, 94° 22′ 22″·85.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Poteau	298	48	33·09	118	55	56·58	4·349626
Pinnacle	241	54	15·25	62	05	17·48	4·518284
Poteau (2)	0	59	51·99	180	59	47·13	4·091545
Sugarloaf	58	49	04·79	238	45	47·12	4·008536
Fort Smith	171	22	46·66	351	20	45·80	4·547466
South Base	98	53	40·54	278	47	20·48	4·229148
Cavanal	89	21	30·97	269	10	57·02	4·446473
North Base	114	31	38·31	294	26	05·63	4·206813

EAST POTEAU.

At east end of Poteau range, about 10 miles northwest of Waldron, Scott Co., Ark. Has most of the timber cleared from the summit.

Permanent mark: Lone oak tree.

[Latitude, 34° 58′ 32″·51. Longitude, 94° 09′ 30″·16.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
White Oak	269	09	28·38	89	16	49·26	4·290232
Pinnacle	199	58	08·28	20	01	45·45	4·446743
Peak	118	55	56·58	298	48	33·09	4·349626
Poteau (2)	85	36	18·68	265	28	50·94	4·298333
Blue Mountain	342	34	49·11	162	38	35·83	4·528324
Black Fork	33	13	35·50	213	06	24·02	4·544975

PINNACLE.

Knob on ridge about 5 miles south of Charleston, Franklin Co., Ark. Has all timber cleared from summit. It was also used as an azimuth station.

Permanent mark: Lone tree, blazed near foot.

[Latitude, 35° 12′ 45″·51. Longitude, 94° 03′ 12″·44.]

To station.	Azimuth.			Back azimuth			Log. dist.
	°	′	″	°	′	″	*Meters.*
White Oak........	339	06	55·10	150	10	40·11	4·444739
Magazine..........	277	47	44·40	98	01	51·99	4·574789
East Poteau.......	20	01	45·45	199	58	08·28	4·446743
Peak..............	62	05	17·48	241	54	15·25	4·518284

BLUE MOUNTAIN.

Station on a high peak about 5 miles southwest of Buck Knob post-office, Scott Co., Ark. Summit entirely cleared of brush.

Permanent mark: Stump of tree on highest part.

[Latitude, 34° 41′ 07″·21. Longitude, 94° 02′ 53″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Poteau.......	162	38	35·83	342	34	49·11	4·528324
White Oak.........	196	12	02·72	16	15	35·23	4·529249

WHITE OAK.

High mountain about 12 miles northeast of Waldron, Scott Co., Ark. Has all timber cleared off the summit, though there is still some large timber standing on the north side.

Permanent mark: Post-oak tree.

[Latitude, 34° 58′ 41″·14. Longitude, 93° 56′ 41″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Round.............	326	29	52·59	146	36	35·80	4·5120745
Magazine..........	232	35	32·38	52	45	52·63	4·5363977
Pinnacle..........	159	10	40·11	339	06	55·10	4·4447392
East Poteau.......	89	16	49·26	269	09	28·38	4·290232
Blue Mountain.....	16	15	35·23	196	12	02·72	4·5292490

MAGAZINE.

Station on middle hump of Magazine Mountain, in Logan Co., Ark. Has about 5 acres of timber cut down and has still a great deal of large timber standing.

Permanent mark: Large oak tree trimmed up. The platform for observing was built around this tree, 44 feet from the ground.

[Latitude, 35° 09′ 57″·68. Longitude, 93° 38′ 41″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Powell	328	14	19·05	148	24	35·83	4·7159107
Bunker Hill	293	32	16·10	113	43	07·95	4·4959055
Muddy Creek Mountain	346	53	14·98	166	57	06·48	4·6558448
Round	11	12	53·87	191	09	19·66	4·6893775
White Oak	52	45	52·63	232	35	32·38	4·5363977
Pinnacle	98	01	51·99	277	47	44·40	4·5747892

ROUND.

Peak just west of "Old Missouri road" near head waters of Cedar Creek in Montgomery Co., Ark. Has all timber cleared off the summit.

Permanent mark: Post-oak tree.

[Latitude, 34° 44′ 00″·72. Longitude, 93° 44′ 55″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Muddy Creek Mountain	258	50	32·68	78	57	56·07	4·3044880
Magazine	191	09	19·66	11	12	53·87	4·6893775
White Oak	146	36	35·80	326	29	52·59	4·5120745

MUDDY CREEK MOUNTAIN.

Knob on ridge 6 or 7 miles south of Onyx, Yell Co., Ark. Has most of timber cleared off the summit.

Permanent mark: Pine tree.

[Latitude, 34° 46′ 06″·68. Longitude, 93° 31′ 57″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Magazine	166	57	06·48	346	53	14·98	4·6558448
Powell	270	26	03·47	90	32	26·84	4·2328765
Round	78	57	56·07	258	50	32·68	4·3044880

ALLEN PEAK.

High peak 3 miles northwest of Onyx, Yell Co., Ark. Has all timber chopped down on top.

Permanent mark: Post-oak tree.

[Latitude, 34° 51′ 06″·10. Longitude, 93° 28′ 14″·79]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Powell	309	20	57·86	129	25	14·29	4·1694563
Bunker Hill	209	53	28·04	29	58	18·13	4·4107648

POWELL.

High peak of Fourche range, in Garland Co., Ark., 30 miles northwest of Hot Springs.

Permanent mark: Black oak tree.

[Latitude, 34° 46′ 01″·91. Longitude, 93° 20′ 45″·57.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Smith	269	20	00·07	89	30	48·24	4·4609414
Bunker Hill	182	37	01·07	2	37	33·78	4·5013612
Magazine	148	24	35·83	328	14	19·05	4·7159107
Muddy Creek Mountain	90	32	26·84	270	26	03·47	4·2328765
Allen Peak	129	25	14·29	309	20	57·86	4·1694563

BUNKER HILL.

Highest knob near Danville, Yell Co., Ark. All timber has been chopped off the summit.

Permanent mark: Post oak tree.

[Latitude, 35° 03′ 10″·25. Longitude, 93° 19′ 48″·41.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Fourche	275	00	52·92	95	17	28·01	4·6445536
Smith	318	48	11·64	138	58	29·43	4·6198532
Powell	2	37	33·78	182	37	01·07	4·5013612
Magazine	113	42	07·95	293	32	16·10	4·4959055
Spring Mountain	180	58	37·00	0	58	44·00	4·2465800
Allen Peak	29	58	18·13	209	53	28·04	4·4107648

SPRING MOUNTAIN.

High, flat mountain on line between Yell and Logan counties, about 15 miles southwest of Dardanelle, Ark. Lines of sight have been cut out to different stations.

Permanent mark: Stump of pine tree 20 feet high, about 10 feet north of signal, with observing platform built around it. The instrument was mounted on this stump.

[Latitude, 35° 12′ 42″·06. Longitude, 93° 19′ 36″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Fourche	296	13	11	116	29	41	4·68706
Bunker Hill	0	58	44	180	58	37	4·24658

SMITH.

High mountain in Saline Co., Ark., 18 miles north of Hot Springs. All timber has been cleared from top except one black oak tree.

Permanent mark: Black oak tree.

[Latitude, 34° 46′ 11″·34. Longitude, 93° 01′ 49″·01.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blocher	302	38	07·21	122	44	32·65	4·3108946
Moss	258	09	06 03	78	21	25·50	4·5268175
Fourche	211	07	39·04	31	13	53·11	4·5060766
Bunker Hill	138	58	29·43	318	48	11·64	4·6198532
Powell	89	30	48·24	269	20	00·07	4·4609414

BLOCHER.

Low wooded ridge, 3 miles east of Blocher, Saline Co., Ark.

Permanent mark: Lone pine tree.

[Latitude, 34° 40′ 12″·75. Longitude, 92° 50′ 32″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Smith	122	44	32·65	302	38	07·21	4·3108946
Moss	221	16	53·51	41	22	46·25	4·3772020

MOSS.

A sharp rocky peak, 20 miles west of Little Rock, in Saline Co., Ark.

Permanent mark: Lone pine tree just below summit.

[Latitude, 34° 49′ 53″·56. Longitude, 92° 40′ 13″·42.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shinall	283	16	36·51	103	22	32·66	4·2119800
Reynolds	228	47	19·08	48	54	08·65	4·3826270
Fourche	141	42	15·37	321	36	07·97	4·4191624
Smith	78	21	25·50	258	09	06·03	4·5268175
Blocher	41	22	46·25	221	16	53·51	4·3772020

SHINALL.

A high, flat mountain, 15 miles northwest of Little Rock, Pulaski Co., Ark. About 8 acres of timber have been cut down. Some timber is still standing on east and west ends. Station can be reached on horseback from Mat Brown's on south side, and also from north side.

Permanent mark: Tall oak trimmed up.

[Latitude, 34° 47′ 51″·69. Longitude, 92° 29′ 49″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Granite	303	13	42·79	123	20	44·03	4·352013
Big Rock	278	59	21·57	99	06	09·00	4·264459
Reynolds	186	46	27·27	366	47	19·87	4·296138
Moss	103	22	32·66	283	16	36·51	4·211980

BIG ROCK.

Station on top of cupola, situated on bluff of Big Rock, 2½ m northwest of Little Rock, Pulaski Co., Ark.

Permanent mark: Flag pole on cupcla of hotel.

[Latitude, 34° 46′ 17″·88. Longitude, 92° 17′ 55″·49.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
West Base	285	10	50·05	105	13	19·54	3·8393960
Granite	356	09	03·15	176	09	17·39	3·9765670
Shinall	99	06	09·00	278	59	21·57	4·2644590
Reynolds	145	00	13·52	324	54	17·76	4·4396040
Maumelle	114	01	36·67	293	55	11·78	4·2731768

WEST BASE.

Near Little Rock, Ark., 2½ miles east of Argenta, Pulaski Co., Ar on land owned by J. J. Martin, on prolongation of tangent of t Althimer branch of St. Louis, Arkansas and Texas Railway.

Permanent mark: Rock 5 by 7 by 48 inches, top just flush with s face, cross cut on iron bolt sunk in stone. Reference, rock 9·7 feet nort another 10·1 feet west, and another 9·5 feet south. All have arro pointing to center.

[Latitude, 34° 45′ 19″·09. Longitude, 92° 13′ 33″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Post-office	77	35	52·76	257	34	14·69	3·6513178
East Base	294	10	39·62	114	12	27·11	3·7208870
Granite	38	18	58·59	218	16	43·49	3·9884370
Big Rock	105	13	19·54	285	10	50·05	3·8393960

EAST BASE.

Near Little Rock, Ark., 6 miles east of Argenta, Pulaski Co., Ark close to track of Althimer branch of St. Louis, Arkansas and Tex Railway.

Permanent mark: Rock sunk in swampy soil 15·5 feet north center of track. Iron bolt sunk in stone and cross cut on bolt. Roc sunk in center of track, top flush with roadbed, arrowhead pointing t center.

[Latitude, 34° 44′ 09″·15. Longitude, 92° 10′ 24″·73.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Post-office	97	25	51·31	277	22	25·79	3·966162
West Base	114	12	27·11	294	10	39·62	3·720887

GRANITE.

Also called Fourche Mountain, 4½ miles south of Little Rock, Pulaski Co., Ark. A long, nearly level ridge, heavily timbered. A wagon road runs nearly to station. Instrument mounted on stump of tree nearly 12 feet high. Lines of sight were cut through the timber.

Permanent mark: Stump 12 feet high.

[Latitude, 34° 41′ 11″·10. Longitude, 92° 17′ 30″·50.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
West Base	218	16	43·49	38	18	58·59	3·988437
Post-office	193	55	58·39	13	56	35·49	3·837660
Big Rock	176	09	17·39	356	09	08·15	3·976567
Shinall	123	20	44·03	303	13	42·79	4·352013

POST-OFFICE.

Station on public building, Little Rock, Pulaski Co., Ark. Instrument set on roof, near flag pole, to which all the angles are reduced.

Permanent mark: U. S. C. & G. S. astronomical station in post-office grounds. Stone post underground.

[Latitude, 34° 44′ 47″·83. Longitude, 92° 16′ 25″·36.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
West Base	257	34	14·69	77	35	52·76	3·651318
East Base	277	23	25·79	97	25	51·31	3·966162
Granite	13	56	35·49	193	55	58·39	3·837660

MAUMELLE.

A high, steep, rocky pinnacle, 12 miles west of north from Little Rock, Pulaski Co., Ark. The top is barren and covered with loose rock; sides very precipitous.

Permanent mark: Hole drilled in rock.

[Latitude, 34° 50′ 25″·22. Longitude, 92° 29′ 09″·79.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Rock	293	55	11·78	114	01	36·67	4·2731768
Reynolds	185	04	12·92	5	04	42·76	4·1750859
Warsaw	249	44	55·92	69	56	32·46	4·5176680

REYNOLDS.

A hump on a ridge, 2½ miles west of Mayflower, Faulkner Co., Ark. Has all the timber cut on south and west sides; timber is yet standing on north and east sides.

Permanent mark: Stump sawed off 4 feet from ground about 18 feet north of signal.

[Latitude, 34° 58′ 28″·95. Longitude, 92° 28′ 17″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Maumelle	5	04	42·76	185	04	12·92	4·1750859
Big Rock	324	54	17·76	145	00	13·52	4·4396040
Shinall	6	47	19·87	186	46	27·27	4·2961880
Moss	48	54	08·65	228	47	19·08	4·3896270
Fourche	97	53	35·54	277	40	36·96	4·5408876
Burrow	131	33	04·59	311	24	21·22	4·4886580
Point Pisgah	174	52	56·54	254	52	22·81	4·2232200
Hump	209	17	29·04	29	26	07·43	4·6671490
Cox	248	57	30·20	64	05	09·91	4·3539590
Warsaw	276	46	09·11	96	57	16·94	4·4789880

FOURCHE.

Highest point on range, 3 miles northwest of Perryville, Perry Co., Ark. Summit cleared of timber.

Permanent mark: Oak tree standing alone.

[Latitude, 35° 01′ 01″·68. Longitude, 92° 50′ 55″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bunker Hill	95	17	28·01	275	00	52·92	4·6445536
Burrow	215	44	06·77	35	48	23·43	4·2866586
Point Pisgah	249	56	20·88	70	08	47·00	4·5440928
Reynolds	277	40	36·96	97	53	35·54	4·5408816
Moss	321	36	07·97	141	42	15·37	4·4191624
Smith	31	13	53·12	211	07	39·04	4·5060766
Spring Mountain	116	29	41·00	296	13	11·0	4·6870600

WARSAW.

Warsaw is a small, round, sharp peak one-half mile south of Warsaw, Pulaski Co., Ark., and 7 miles northwest of Jacksonville, on land owned by John See.

Permanent mark: Lone tree.

[Latitude, 34° 56′ 33″·48. Longitude, 92° 08′ 52″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Maumelle	69	56	32·46	249	44	55·92	4·517668
Reynolds	96	57	16·94	276	46	09·11	4·473988

BURROW.

On heavily timbered knob one-half mile northeast of Morrillton, Conway Co., Ark. Instrument elevated 60 feet.

Permanent mark: Stone marked with cross.

[Latitude, 35° 09′ 31″·11. Longitude, 92° 43′ 28″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Fourche	35	48	23·43	215	44	06·77	4·2866586
Reynolds	311	24	21·22	131	33	04·59	4·4886580
Point Pisgah	279	48	06·21	99	56	15·76	4·3403042
Pig Mountain	228	06	11·43	48	12	35·94	4·3546568
Black Mountain	185	25	18·98	5	26	52·53	4·6344878
Evans Mountain							4·5873924

COX.

Cox is on the highest part of a ridge 10 miles east of Conway and 3 miles southwest of Vilonia, Faulkner Co., Ark., on land owned by Mr. Cox, and is 3 miles south of Senator Donnaway's residence.

Permanent mark: Black-oak tree.

[Latitude, 35° 03′ 50″·10. Longitude, 92° 14′ 56″·57.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Point Pisgah	107	18	03·84	287	09	49·40	4·358075
Reynolds	64	05	09·91	243	57	30·20	4·353959

POINT PISGAH.

Hump on ridge 4 miles northwest of Conway, Faulkner Co., Ark.

Permanent mark: Oak tree.

[Latitude, 35° 07′ 29″·37. Longitude, 92° 29′ 16″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Reynolds	354	52	22·00	174	52	56·60	4·2232259
Fourche	70	08	47·00	249	56	20·88	4·5440928
Burrow	99	56	15·76	279	48	06·21	4·3403042
Pig Mountain	166	02	30·45	346	00	43·54	4·2883132
Hump	225	24	36·33	45	33	49·68	4·531645
Cox	287	09	49·40	107	18	03·84	4·358075

HUMP.

Hump is an isolated hill about 300 feet above the surrounding country 1½ miles northeast of Enders, Faulkner Co., Ark., and 3 miles south of Quitman. Is about one-fourth mile long east and west and was very heavily timbered. The eastern half of the hill was cleared of timber except one tree.

Permanent mark: Lone tree.

[Latitude, 35° 20′ 23″·13. Longitude, 92° 13′ 17″·40.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Point Pisgah	45	33	49·68	225	24	36·33	4·531645
Reynolds	29	26	07·43	209	17	29·04	4·667149

PIG MOUNTAIN.

High ridge 3 miles northeast of Springfield, Conway Co., Ark. Permanent mark: Wooden post under tripod.

[Latitude, 35° 17′ 40″·98. Longitude, 92° 32′ 22″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Point Pisgah	346	00	43·54	166	02	30·45	4·2883132
Burrow	48	12	35·94	228	06	11·43	4·3546478
Black Mountain	155	25	58·75	335	21	06·11	4·4855891
Evans Mountain	127	12	04·80	307	01	06·37	4·5560437

BLACK MOUNTAIN.

High knob 5 miles northwest of Scotland, Van Buren Co., Ar Timber chopped off the top excepting one black-oak tree.

Permanent mark: Black-oak tree standing alone.

[Latitude, 35° 32′ 43″·48. Longitude, 92° 40′ 47″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Burrow	5	26	52·53	185	25	18·98	4·6314878
Pig Mountain	335	21	06·11	155	25	58·75	4·4855891
Evans Mountain	69	04	46·56	248	58	39·39	4·2318370
Pine Hill	175	10	38·18	355	10	18·73	4·0000234
Walker							4·3347268

EVANS MOUNTAIN.

Highest part of flat top mountain in Pope Co., Ark., 10 miles nort west of Cleveland. Lines of sight cut out to different primary point Permanent mark: Oak tree.

[Latitude, 35° 29′ 25″·31. Longitude, 92° 51′ 19″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pig Mountain	307	01	06·37	127	12	04·80	4·5560437
Burrow	342	04	23·05	162	08	54·98	4·5873924
Black Mountain	248	58	39·39	69	04	46·56	4·2318370
Pine Hill	223	07	20·99	43	13	09·12	4·3430697
Walker	178	03	11·43	358	02	55·73	4·3004644
Raspberry Mountain	152	43	16·64	332	39	29·57	4·3308122

PINE HILL.

Highest knoll near Alread, Van Buren Co., Ark. It has all the timber cleared off but one tree.

Permanent mark: Spike in stump 21 feet north of lone black-oak tree.

[Latitude, 35° 38′ 06″·80. Longitude, 92° 41′ 20″·52.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black Mountain	355	10	18·73	175	10	38·18	4·0000234
Evans Mountain	43	13	09·12	223	07	20·99	4·3430697
Walker	103	56	55·14	283	50	50·52	4·2098001
Reeves	156	01	52·89	336	00	09·54	4·0399253
Walnut Mountain	263	19	35·95	83	25	55·01	4·2168164
Red Hill							4·2678041

WALKER.

High knoll near head of Illinois Bayou, Pope Co., Ark. Timber all cleared off except one black-oak tree.

Permanent mark: Black-oak tree.

[Latitude, 35° 40′ 13″·08. Longitude, 92° 51′ 46″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Evaus Mountain	358	02	55·73	178	03	11·43	4·3004644
Pine Hill	283	50	50·52	103	56	55·14	4·2098001
Raspberry Mountain	84	12	58·86	264	09	27·02	3·9630864
Round (2)	159	47	28·65	339	44	46·59	4·3042510
Reeves	241	27	14·69	61	31	36·31	4·1081476
Black Mountain							4·3347268

RASPBERRY MOUNTAIN.

High point on the old mountain road in Pope Co., Ark., about 10 miles southwest of Witts Springs. All the timber was cut off except one white-oak tree.

Permanent mark: White-oak tree.

[Latitude, 35° 39′ 42″·89. Longitude, 92° 57′ 49″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Evans Mountain	332	39	29·57	152	43	16·64	4·3308122
Walker	264	09	27·02	84	12	58·86	3·9630864
Round (2)	186	12	26·54	6	13	16·77	4·3000109

ROUND (2).

High knob about 8 miles northwest of Witts Springs, Searcy Co , Ark. All timber chopped off the top, and an observing platform, 25 feet high, built around the trunk of a tree.

Permanent mark: White-oak tree.

[Latitude, 35° 50′ 26″·51. Longitude, 92° 56′ 23″·41.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Raspberry Mountain	6	13	16·77	186	12	26·54	4·3000109
Walker	339	44	46·59	159	47	28·65	4·3042510

WALNUT MOUNTAIN.

High knob 10 miles northwest of Clinton, Van Buren Co., Ark., the north bank of Archies Fork of Red River. Has all timber chopp off the top except one white-oak tree. Instrument elevated 20 feet.

Permanent mark: White-oak tree.

[Latitude, 35° 39′ 08″·44. Longitude, 92° 30′ 30″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Hill	83	25	55·01	263	19	35·95	4·2168164
Reeves	111	22	27·75	291	14	24·90	4·3490447
Red Hill	174	45	15·45	354	44	58·25	3·9086639
Pond Mountain	261	09	06·76	81	20	13·95	4·4634886

REEVES.

High knob in Searcy Co., Ark., 7 miles northwest of Copeland a one-half mile from Dr. Reeves's residence. Has all the timber clear off the top.

Permanent mark: Black-oak tree.

[Latitude, 35° 43′ 31″·74. Longitude, 92° 44′ 17″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Walker	61	31	36·31	241	27	14·69	4·1081476
Pine Hill	336	00	09·54	156	01	52·89	4·0399253
Walnut Mountain	291	14	24·90	111	22	27·75	4·3490447
Red Hill	270	04	16·74	90	12	02·81	4·3023494
Brush Mountain	227	35	32·89	47	39	53·41	4·1805321

BRUSH MOUNTAIN.

High knob 6½ miles southeast of Marshall, Searcy Co., Ark. H all timber cleared off the top except one white-oak tree.

Permanent mark: Wooden post set 3 feet in ground.

[Latitude, 35° 49′ 03″·11. Longitude, 92° 36′ 52″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Reeves	47	39	53·41	227	35	32·89	4·1805321
Red Hill	319	10	53·78	139	14	19·82	4·1320095
Blue Mountain (2)	255	16	36·82	75	25	24·38	4·3686265

RED HILL.

Midway between Clinton, Van Buren Co., Ark., and Marshall, an right on the road; the highest point in that neighborhood. Has a timber chopped off the top except one black-oak tree.

Permanent mark: Wooden post with spike in top.

[Latitude, 35° 43′ 30″·27. Longitude, 92° 30′ 59″·57.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Reeves	90 12 02·81	270 04 16·74	4·3023494
Walnut Mountain	354 44 58·25	174 45 15·45	3·9006639
Brush Mountain	139 14 19·82	319 10 53·78	4·1320095
Pond Mountain	276 57 19·91	97 08 44·00	4·4725741
Blue Mountain (2)	220 22 33·70	40 27 54·52	4·3271528
Pine Hill			4·2678041

BLUE MOUNTAIN (2).

Highest point in the neighborhood of Alco, Stone Co., Ark., and 1½ miles south of post-office. Has all the timber cleared off the top except one white-oak tree.

Permanent mark: Cross cut on stone and pile of rocks over marked stone.

[Latitude, 35° 52′ 14″·86. Longitude, 92° 21′ 51″·18.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Brush Mountain	75 25 24·38	255 16 36·82	4·3686265
Red Hill	40 27 46·26	220 22 25·46	4·3271528
Pond Mountain	321 37 18·33	141 43 22·98	4·4023817
Irons Point	272 23 46·92	92 35 57·36	4·4956724
Finch Mountain	302 08 34·35	122 15 05·48	4·2971750
Pilot Mountain	231 20 11·12	51 32 15·03	4·5963290
Alpha	210 22 32·57	30 31 23·60	4·6491082

FINCH MOUNTAIN.

Mound on flat top mountain 6 miles southwest of Mountain View, Stone Co., Ark. Has lines cut out to different primary stations.

Permanent mark: Post 15·3 feet northeast of lone hickory tree.

[Latitude, 35° 46′ 32″·23. Longitude, 92° 10′ 42″·94.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Blue Mountain (2)	122 15 05·48	302 08 34·35	4·2971750
Pond Mountain	6 54 45·04	186 54 18·99	3·9693555
Irons Point	237 36 07·68	57 41 46·20	4·2352699

POND MOUNTAIN.

Flat top mountain in Cleburne Co., Ark., 6 miles east of Rushing. All timber cleared to west and north and line cut out eastward.

Permanent mark: White oak tree.

[Latitude, 35° 41′ 32″·08. Longitude, 92° 11′ 27″·52.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Red Hill	97 08 35·76	276 57 11·67	4·4725741
Blue Mountain (2)	141 43 22·98	321 37 18·33	4·4023817
Walnut Mountain	81 20 13·05	261 09 06·78	4·4634886
Finch Mountain	186 54 18·99	6 54 45·04	3·9693555

IRONS POINT.

Flat top spur of the Blue range 6 miles east of Mountain View, Stone Co., Ark. Has a large amount of timber cut and an observing platform, 15 feet high, built around the trunk of a tree.

Permanent mark: Trunk of tree 38 feet east of oak tree used as signal.

[Latitude, 35° 51′ 30″·69. Longitude, 92° 01′ 04″·50.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Finch Mountain	57	41	46·20	237	36	07·68	4·2353699
Blue Mountain (2)	92	35	57·36	272	23	46·92	4·4956724
Pilot Mountain	179	11	33·16	359	11	24·57	4·4145606
Cedar Mountain	242	08	54·76	62	15	45·00	4·2973891
Deane Mountain	296	59	00·58	117	08	45·53	4·4501907
Mount Etna	265	21	27·66	85	30	48·47	4·3818364

DEANE MOUNTAIN.

High spur of the Blue range just south of White River and 6 miles southwest from Batesville, Independence Co., Ark. Has timber cleared off except one tree just below the summit.

Permanent mark: Cross cut on large rock about 10 feet east of the signal tree.

[Latitude, 35° 44′ 34″·43. Longitude, 91° 44′ 24″·55.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Irons Point	117	08	46·53	296	59	00·58	4·4501907
Mount Etna	165	50	08·20	355	49	43·16	4·1698300

MOUNT ETNA.

High, cleared, open field one-fourth of a mile north of Cushman, Independence Co., Ark.

Permanent mark: Wooden post set under a painted tripod signal.

[Latitude, 35° 52′ 32″·89. Longitude, 91° 45′ 07″·36.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot Mountain	134	44	13·03	314	34	42·04	4·5343414
Irons Point	85	30	48·47	265	21	27·66	4·3818364
Deane Mountain	355	49	43·16	165	50	08·20	4·1698300

CEDAR MOUNTAIN.

Highest knob within 5 miles of Barren Fork, Izard Co., Ark., 4 miles southwest of post-office. Has all timber chopped off the top except one pine tree.

Permanent mark: × cut in solid sandstone rock 11·5 feet northeast of signal tree.

[Latitude, 35° 56′ 30″·75. Longitude, 91° 49′ 24″·90.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Irons Point............	62	15	45·00	242	08	54·76	4·2973891
Pilot Mountain........	133	08	12·61	313	01	12·61	4·3889303

PILOT MOUNTAIN.

High knob 6 miles west of Melbourne, Izard Co., Ark. All timber has been chopped off except one tree.

Permanent mark: Lone tree.

[Latitude, 36° 05′ 33″·37. Longitude, 92° 01′ 19″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Irons Point............	359	11	24·57	179	11	33·16	4·4145606
Blue Mountain (2)	51	32	15·03	231	20	11·12	4·5963290
Mount Etna	314	34	42·04	134	44	13·03	4·5343414
Cedar Mountain	313	01	12·61	133	08	12·51	4·3889303
Alpha	149	13	15·94	329	10	01·45	4·2065745
Matny Mountain	115	22	14·83	295	11	50·55	4·4662655
Salem..................	204	13	15·47	24	18	50·89	4·5375408

ALPHA.

High knoll 3 miles north of Pineville, Izard Co. Ark. All timber has been cleared off but one tree.

Permanent mark: Cross cut in solid rock.

[Latitude, 36° 13′ 01″·65. Longitude, 92° 06′ 48″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot Mountain........	329	10	01·45	149	13	15·94	4·2065745
Blue Mountain (2)	30	31	23·60	210	22	32·57	4·6491082
Matny Mountain	85	54	02·87	265	46	52·42	4·2612358
Salem..................	231	43	58·44	51	52	49·51	4·4545699
Wallace Knob	123	14	01·47	303	04	39·95	4·451507

SALEM.

High knoll 3 miles west of Salem, Fulton Co., Ark. All the timber was cleared off the knoll.

Permanent mark: Cross cut in stone about 10 feet southeast of signal and large pile of stones.

[Latitude, 36° 22′ 33″·15. Longitude, 91° 51′ 51″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Alpha	51	52	49·51	231	43	58·44	4·4545699
Pilot Mountain...	24	18	50·89	204	13	15·47	4·5375408

WALLACE KNOB.

Wallace Knob is 2 miles northeast of Mountain Home, Baxter Co., Ark., in plain view of the town. It is about 500 feet above the surrounding country; is nearly round, with about 1 acre on top, which is cleared of timber, except one tree.

Permanent mark: Lone tree.

[Latitude, 36° 21′ 23″·63. Longitude, 92° 22′ 37″·71.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Alpha	303	04	39·95	123	14	01·47	4·451507
Matny Mountain	341	51	44·65	161	53	54·93	4·247176
Pine (2)	103	10	06·42	282	59	22·92	4·443375

MATNY MOUNTAIN.

High knob just south of White River and 15 miles south of Mountain Home, Baxter Co., Ark.; has most of the timber chopped off the top.

Permanent mark: Lone tree with spike in trunk.

[Latitude, 36° 12′ 18″·70. Longitude, 92° 18′ 57″·43.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot Mountain	295	11	50·55	115	22	14·83	4·4662655
Alpha	265	46	52·42	85	54	02·87	4·2612358
Boat	82	28	38·80	262	03	09·28	4·815415
Pine (2)	125	25	58·26	305	13	05·54	4·601004
Wallace Knob	161	53	54·93	341	51	44·65	4·247176

PINE (2).

Just south of White River, 20 miles northwest of Mountain Home, and 1 mile northwest of Stone, Marion Co., Ark., on a hogback ridge running northeast and southwest, about 1,000 feet long, which is entirely cleared of timber.

Permanent mark: Lone tree.

[Latitude, 36° 24′ 47″·43. Longitude, 92° 40′ 42″·55.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Matny Mountain	305	13	05·54	125	25	58·26	4·601004
Wallace Knob	282	59	22·92	103	10	06·42	4·443376
Lead	93	49	03·92	273	37	05·62	4·480227
Boat	45	19	37·48	225	06	56·22	4·655610

LEAD.

A bald knob about 400 feet above the surrounding country, 6 miles due west from Lead Hill, Boone Co., Ark. There was a small honey-locust tree on top, which was used for signal. The top is flat, covered with rocks, and is about 2 acres in extent.

Permanent mark: Cross cut on solid rock, 10 inches below surface, 10·3 feet northeast of signal tree.

[Latitude, 36° 25′ 50″·96. Longitude, 93° 00′ 52″·38.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine (2)	273	37	05·62	93	49	03·92	4·480227
Boat	3	15	34·18	183	14	48·59	4·530009
Trout	149	14	09·46	329	09	26·59	4·363505
Kennedy	41	51	48·43	221	44	18·81	4·453208
Cedar	192	11	53·38	12	13	06·98	4·163281

BOAT.

A very sharp peak at north end of Boat Mountain, in the northeast corner of Newton Co., Ark., 9 miles southeast of Harrison and 3 miles southwest of Valley Springs, Ark. Has timber cleared from top.

Permanent mark: Lone tree.

[Latitude, 36° 07′ 33″·17. Longitude, 93° 02′ 09″·29.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Matny Mountain	262	03	09·28	82	28	38·80	4·815415
Pine (2)	225	06	56·22	45	19	37·48	4·655610
Kennedy	126	40	51·62	306	34	09·11	4·326916
Lead	183	14	48·59	3	15	34·18	4·530009

KENNEDY.

On land owned by Mr. Kennedy and sometimes known by the name of Pilot. It is 6 miles west of Harrison and 1 mile south of Batavia, Boone Co., Ark. It is a bald rock about 700 feet above the surrounding country.

Permanent mark: U. S. G. S. cross cut in rock.

[Latitude, 36° 14′ 24″·06. Longitude, 93° 13′ 31″·11.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boat	306	34	09·11	126	40	51·62	4·326916
Lead	221	44	18·81	41	51	48·43	4·453203
Cedar	211	46	42·22	31	55	25·96	4·619886
Pyron	121	27	09·76	301	16	08·01	4·513776
Bald	172	10	42·33	352	08	11·46	4·666043
Watson	92	55	55·06	272	47	08·63	4·3475122

CEDAR.

A sharp peak entirely bald on side and cleared of timber on top. It is 2 miles southeast from Cedar Creek and 15 miles southeast from Forsyth, Taney Co., Mo.

Permanent mark: Lone tree.

Latitude, 36° 33′ 32″·76. Longitude, 92° 58′ 48″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kennedy	31	55	25·96	211	46	43·22	4·619886
Lead	12	13	06·98	192	11	53·38	4·163281
Hammond	175	30	16·17	355	29	33·87	4·350669
Bald	110	30	46·48	290	19	28·75	4·479139
Trout	110	39	45·71	290	33	48·66	4·201744

HAMMOND.

Located about 5 miles north of Taney City, Taney Co., Mo., a about 1 mile east of Taney City and Springfield road, on a small, sha knob known as Hammond Knob.

Permanent mark: Lone tree.

[Latitude, 36° 45′ 37″·92. Longitude, 92° 59′ 59″·53.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald	65	58	32·92	245	47	55·99	4·462055
Cedar	355	29	33·87	175	30	16·17	4·350669

TROUT.

A low, flat hill 1 mile southeast from Kirbyville, Taney Co., M Has most of the timber cleared from the top.

Permanent mark: Lone tree.

[Latitude, 36° 36′ 34″·49. Longitude, 93° 08′ 47″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cedar	290	33	48·66	110	39	45·71	4·201744
Lead	329	09	26·59	149	14	09·46	4·363505

BALD.

On north side of White River, in Stone Co., Mo. It is about 1 miles west of Kirbyville, Taney Co., Mo., from which place it is plainl visible. It is reached by crossing White River at the north of Turke Creek. Is almost entirely bald on the side and has all timber cleare from top.

Permanent mark: Lone tree.

[Latitude, 36° 39′ 13″·89. Longitude, 93° 17′ 45″·27.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kennedy	352	08	11·46	172	10	42·33	4·666043
Cedar	290	19	28·75	110	30	46·48	4·479139
Pilot Knob	62	00	05·78	241	51	08·48	4·404577
Pyron	36	40	05·00	216	31	31·14	4·556682
Bread Tray	63	22	02·76	243	15	27·92	4·265078
Hammond	245	47	55·99	65	28	32·92	4·462055

BREAD TRAY.

Bread Tray Mountain, Barry Co., Mo., is 5 miles northwest of Pilot Knob. It is about one-eighth mile long and quite narrow. Has all timber cleared from summit except one tree.

Permanent mark: Lone tree.

[Latitude, 36° 34′ 45″·63. Longitude, 93° 28′ 47″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald	243	15	27·92	63	22	02·76	4·265078
Pyron	13	39	30·16	193	37	30·36	4·327532

PILOT KNOB.

Pilot Knob is about 15 miles north of Berryville, Ark., and 2 miles south of Viola, Stone Co., Mo. It is a sharp knob about 400 feet above surrounding country. It has all timber cleared from summit except one tree, left for signal.

Permanent mark: Lone tree.

[Latitude, 36° 32′ 46″·34. Longitude, 93° 32′ 46″·49.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pyron	356	49	39·26	176	50	01·71	4·230640
Bald	241	51	08·48	62	00	05·78	4·404577
Lohmer	132	19	52·09	312	14	02·66	4·294134
Sugar	73	10	31·27	252	58	00·89	4·516058

LOHMER.

Station on a ridge north of the Cassville and Shell Knob road, about 11 miles southeast of Cassville, Barry Co., Mo., and 1 mile east of Judge Lohmer's house. A 48-foot scaffold was built around a large black-oak tree, which is trimmed up.

Permanent mark : Black-oak tree.

[Latitude, 36° 39′ 56″·00. Longitude, 93° 42′ 32″·43.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot Knob	312	14	02·66	132	19	52·09	4·294134
Sugar	36	26	08·01	216	19	25·65	4·452058
Butterfield	111	05	11·98	290	57	51·92	4·291899

BUTTERFIELD.

On edge of the right of way of the St. Louis and San Francisco Railroad, about halfway between stations Butterfield and Exeter, Barry Co., Mo. Signal scaffold 68 feet high built around a large black-oak tree and projecting above the top of the tree.

Permanent mark: Black-oak tree.

[Latitude, 36° 43′ 43″·96. Longitude, 93° 54′ 48″·91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lohmer	290	57	51·92	111	05	11·98	4·291899
Sugar	357	05	13·28	177	05	49·62	4·475142

SUGAR.

Station on Sugar Mountain, Benton Co., Ark., which is 5 miles southeast of Seligman, Mo., on the Seligman and Eureka Springs road and just west of the road.

Permanent mark: Lone tree.

[Latitude, 36° 27′ 36″·37. Longitude, 93° 53′ 48″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot Knob	252	58	00·89	73	10	31·27	4·5160580
Pyron	282	49	05·60	103	01	57·05	4·5212040
Butterfield	177	05	49·62	357	05	13·28	4·4751420
Lohmer	216	19	25·65	36	26	08·01	4·4520580
Orchard	26	20	06·78	206	13	45·00	4·5601507

PYRON.

Pyron Mountain is about 2 miles northeast of Berryville, Carroll Co., Ark., and is about 800 feet above the town. Has about 2 acres on top and is cleared of timber, except one tree left for signal.

Permanent mark: Lone tree.

[Latitude, 36° 23′ 35″·29. Longitude, 93° 32′ 08″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kennedy	301	16	08·01	121	27	09·76	4·5187760
Bald	216	31	31·14	36	40	05·00	4·5566820
Pilot Knob	176	50	01·71	356	49	39·26	4·2306400
Swain	60	52	49·66	240	44	41·98	4·3711983
Sugar	103	01	57·05	282	49	05·60	4·5212040
Bread Tray	193	37	30·38	13	39	30·16	4·3275320
Watson	340	21	31·29	160	23	45·71	4·2267538

WATSON.

About 15 miles southeast of Berryville, Ark., on divide between Piney and Osage Creeks, and 2 miles north of Piney, Carroll Co., Ark., on public land. It is rather a sharp peak and has all the timber cleared from summit except one tree left for a signal.

Permanent mark: Lone tree.

[Latitude, 36° 15′ 00″·09. Longitude, 93° 28′ 21″·56.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Swain	99	38	46·03	279	28	24·91	4·4244809
Pyron	160	23	45·71	340	21	31·29	4·2267538
Hobbs	50	30	37·87	230	12	18·30	4·7830238
Kennedy	272	47	08·63	92	55	53·06	4·3475122

SWAIN.

About 10 miles south of Eureka Springs, Madison Co., Ark., about one-eighth mile west of the road between Eureka Springs and Hindsville, Ark. On a flat-top mountain, from which all the timber was cleared except one tree.

Permanent mark: Lone tree.

[Latitude, 36° 17′ 23″·38. Longitude, 93° 45′ 52″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pyron	240	44	41·98	60	52	49·66	4·3711983
Watson	279	28	24·91	99	38	46·03	4·4244656
Hobbs	25	26	05·55	205	18	03·99	4·6787670
Rogers	98	30	53·60	278	18	32·60	4·4991011
Orchard	64	03	14·03	243	52	11·63	4·4934958

ROGERS.

In the town of Rogers, Benton Co., Ark., 2 blocks east and 1 block north of railway depot, over center of water tower; elevated 20 feet above the top of the tower, which is 73 feet high and stands in the middle of the street.

Permanent mark: Center of water tower.

[Latitude, 36° 19′ 53″·30. Longitude, 94° 06′ 43″·29.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Orchard	349	53	02·26	169	54	19·47	4·2690330
Swain	278	18	32·60	98	30	53·60	4·4991011
Twin	49	15	48·63	229	06	21·91	4·500107

ORCHARD.

About 3 miles east of Springdale and 8 miles northeast of Fayetteville, Washington Co., Ark., on a flat-top hill which has an orchard growing on it.

Permanent mark: Stone marked $\begin{array}{c|c} \text{U} & \text{S} \\ \text{G} & \text{S} \end{array}$ set in ground.

[Latitude, 36° 09′ 59″·74. Longitude, 94° 04′ 32″·59.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Swain	243	52	11·63	64	03	14·03	4·4934958
Sugar	206	13	45·00	26	20	06·78	4·5601507
Rogers	169	54	19·47	349	53	02·26	4·2690330
Kestler	38	04	26·53	217	59	20·66	4·323958
Twin	85	05	14·10	264	54	31·46	4·436666
Hobbs	345	30	52·55	165	33	51·01	4·4830712

TWIN.

About 15 miles west of Fayetteville, Washington Co., Ark., on the southern of two round peaks. Has all the timber cleared from the summit except one black-oak tree.

Permanent mark: Tree.

[Latitude, 36° 08′ 42″·54. Longitude, 94° 22′ 42″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rogers	229	06	21·91	49	15	48·63	4·500107
Orchard	264	54	31·46	85	05	14·10	4·436666
Drake	32	19	55·01	212	14	52·26	4·382045

KESTLER.

About 5 miles southwest of Fayetteville, Washington Co., Ark., on a flat-topped hill, which was once under cultivation but is now waste land. The small timber was all cleared away, leaving one small white-oak tree, rather toward the south end of the mountain.

Permanent mark: Lone tree.

[Latitude, 36° 01′ 00″·91. Longitude, 94° 13′ 11″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Orchard	217	59	20·66	38	04	26·53	4·323958
Hobbs	301	51	19·42	121	59	22·47	4·385381
Drake	77	20	08·03	256	09	30·68	4·444916
Cane Hill	61	36	15·84	241	27	38·46	4·399889
Skylight	34	36	53·48	214	31	25·92	4·392049
Sloane	341	27	27·20	161	29	46·10	4·271336

HOBBS.

About 12 miles southeast of Fayetteville and 3 miles south of Durham, Washington Co., Ark., on a northern spur of the Boston range of mountains. There is a cornfield on top of the peak in which a grove was standing. This grove of trees was chopped down, with the exception of one large black oak, which was reserved for a signal. Instrument elevated 20 feet.

Permanent mark: Black-oak tree.

[Latitude, 35° 54′ 04″·07. Longitude, 93° 59′ 28″·90.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Watson	230	12	18·30	50	30	87·87	4·7830238
Swain	205	18	03·99	25	26	05·55	4·6787670
Kestler	121	59	22·47	301	51	19·42	4·385381
Sloane	71	44	23·92	251	28	40·50	4·189822
Orchard	165	33	51·01	345	30	52·55	4·4830712

SLOANE.

Sloane is about 15 miles south of Fayetteville, Washington Co., Ark., on a spur of the Boston range. About 5 acres of timber was chopped down to clear the top. Instrument was elevated 15 feet.

Permanent mark: Large white-oak tree.

[Latitude, 35° 51′ 26″·29. Longitude, 94° 09′ 14″·99]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Kestler	161	29	46·10	341	27	27·20	4·271236
Hobbs	251	38	40·50	71	44	23·92	4·189822
Strickler	67	37	14·62	247	30	47·66	4·254126
Skylight	82	37	59·64	262	30	14·16	4·303543
Boston	9	53	35·75	189	53	07·12	3·854295
Wakefield	322	31	04·00	142	35	01·69	4·224813

SKYLIGHT.

About 3 miles west of Strickler, Washington Co., Ark., on a high, round hill, having a house on the highest part. The timber has all been cleared from the top, but has a fringe of trees around the edge, through which lines of sight were cut. The station is just in front of Mr. Donham's house.

Permanent mark: Large black-oak tree.

[Latitude, 35° 50′ 02″·13. Longitude, 94° 22′ 30″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kestler	214	31	25·92	34	36	53·43	4·392049
Sloane	262	30	14·16	82	37	59·64	4·303543
Boston	283	16	57·01	103	24	13·51	4·284353
Cane Hill	135	51	52·07	315	48	42·92	4·065343
Strickler	321	39	55·43	141	41	13·71	3·733676
Lee	357	58	54·14	177	59	12·80	4·358365

CANE HILL.

About 5 miles south of Summers, Washington Co., Ark. Station on the northeast point of a big flat hill, and has lines of sight cut out other primary points.

Permanent mark: Large white-oak tree.

[Latitude, 35° 54′ 32″·67. Longitude, 94° 27′ 53″·07.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Skylight	315	48	42·92	135	51	52·07	4·065343
Kestler	241	27	38·46	61	36	15·84	4·399889

DRAKE.

About 20 miles west of Fayetteville and 1 mile west of Summer Washington Co., Ark., on a long flat hill, the station being on the we end, and lines of sight chopped out to primary stations.

Permanent mark: Lone white-oak tree.

[Latitude, 35° 57′ 41″·53. Longitude, 94° 31′ 16″·56.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kestler	256	09	30·68	77	20	08·03	4·444916
Twin	212	14	52·26	32	19	55·01	4·382045

STRICKLER.

About 1½ miles southwest of Strickler, Washington Co., Ark., ju east of the old wire road, running from Fayetteville southwest. H all the timber cleared from the summit except one tree.

Permanent mark: Large white-oak tree.

[Latitude, 35° 47′ 44″·26. Longitude, 94° 20′ 16″·53.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Skylight	141	41	13·71	321	39	55·43	3·733676
Sloane	247	30	47·66	67	37	14·62	4·254126
Lockard	332	46	12·72	152	49	11·70	4·226613
Lee	7	52	01·94	187	51	02·47	4·272616

BOSTON.

Boston is on the main ridge of the Boston range of mountains a about 1½ miles west of Winslow, Washington Co., Ark., which is the north end of the tunnel of the St. Louis and San Francisco Ra way. Is about 100 feet above the general ridge. Is rather flat on t

The station is near the north end of the hill and has lines of sight cut through to other primary points. Instrument was elevated 15 feet.

Permanent mark: Large black-oak tree.

[Latitude, 35° 47′ 37″·74. Longitude, 94° 10′ 03″·95.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Skylight	103	24	13·51	283	16	57·01	4·284353
Sloane	189	53	07·12	9	53	35·75	3·854295
Wakefield	298	43	48·14	118	48	14·24	4·115503
Cartright	349	26	39·11	169	27	24·15	4·024527

WAKEFIELD.

Wakefield, in Franklin Co., Ark., is about 10 miles southeast of Winslow and 10 miles northeast of Chester. Has all timber cleared from summit except one tree.

Permanent mark: Lone tree.

[Latitude, 35° 44′ 14″·02. Longitude, 94° 02′ 28″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boston	118	48	14·24	298	43	48·14	4·115503
Sloane	142	35	01·69	322	31	04·00	4·224813
Cartright	66	34	46·45	246	31	05·67	4·015411

CARTRIGHT.

Cartright is on a high ridge 3 miles east of Chester, Crawford Co., Ark. The station is the west end of Mr. Cartright's house, which is on the highest ground.

Permanent mark: West end of the comb of the roof.

[Latitude, 35° 42′ 00″·22. Longitude, 94° 08′ 46″·89.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boston	169	27	24·15	349	26	39·11	4·024527
Wakefield	246	31	05·67	66	34	46·45	4·015411

LOCKARD.

Lockard is about 5 miles west of Chester, Crawford Co., Ark., on a round hill, which has all the timber cleared from the summit except one tree.

Permanent mark: Tall black-oak tree.

[Latitude, 35° 39′ 37″·70. Longitude, 94° 15′ 09″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lee	70	52	08·76	250	48	10·76	4·036555
Strickler	152	49	11·70	332	46	12·72	4·226613

LEE.

Lee is about 13 miles west of Chester and 3 miles south of L Creek, Crawford Co., Ark. Is a sharp peak with a small field on to The station is near the center of the summit. Instrument was el vated 15 feet.

Permanent mark: Large black-oak tree.

[Latitude, 35° 37′ 42″·12. Longitude, 94° 21′ 58″·45.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°		″	°	′	″	*Meters.*
Skylight	177	59	12·80	357	58	54·14	4·358365
Strickler	187	51	02·47	7	52	01·94	4·272616
Lockard	250	48	10·76	70	52	08·76	4·036555

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KANSAS.

METHODS OF WORK.

The triangulation in Kansas conducted by the Geological Survey is in three detached belts, each of which starts from a line or lines of the transcontinental triangulation of the U. S. Coast and Geodetic Survey.

The southern belt begins with the line Fulton-Hutton Mound some 20 miles east of the Missouri-Kansas line, and proceeds nearly due west until the Arkansas River is reached at Hutchinson. From here the general course of the river is followed as far as Larned, at which point topographic conditions favored a detour to the west and southwest to Dodge, after which the river was again followed to the present terminus near Hartland.

Field work of triangulation was begun in 1885 by R. U. Goode, who continued it as far as Florence. The instrument used was a Gambey 11-inch repeating theodolite with two verniers reading to ten seconds. No azimuth observations were taken at the time, but a subsequent observation at Florence showed only a very small error. In 1889 this belt was continued westward by H. L. Baldwin, jr., as far as Spearville. The instrument used was a Fauth 8-inch theodolite, No. 362, reading with two microscopes to 2 seconds. Azimuths were taken at intervals of about 50 miles in this and all subsequent work.

At Spearville a base line 7·1 miles in length was measured with a 300-foot steel tape under very favorable conditions. The base line was divided into thirteen sections of 3,000 feet each, two complete measures of each section being made. About half of the sections were measured a third time, when work was stopped by an accident. The resulting probable error of the base is 0·39 inch. An astronomical determination of the latitude and longitude of the Spearville end of the base was made in 1889 by Prof. R. S. Woodward, signals being exchanged with St. Louis on three nights.

In 1889 work was resumed at Spearville, and continued by a series of small but well-proportioned quadrilaterals to its present terminus near Hartland. All of the southern belt west of Florence rests upon the Spearville base. The average errors of closure of the triangles for each year's field work, before station adjustment was made, were respectively 7″·85, 3″·25, and 1″·73.

The northeastern belt of triangulation was executed under the direction of Mr. John H. Renshawe in 1886. The angles were measured by Mr. E. T. Perkins, jr., excepting those from a few of the later stations, which were observed by Mr. George T. Hawkins. The instrument used was the Gambey 11-inch theodolite used during the previous year in the southern belt. The work is based upon the U. S. Coast and Geodetic Survey line Blue Mound-Eckman, near Lawrence, and proceeds in a westerly direction, the axis of triangulation being about parallel to and 20 miles north of the Kansas River.

The northern belt of triangulation, executed by Mr. H. L. Baldwin, jr., in 1890, uses for initial positions three stations of the transcontinental triangulation of the U. S. Coast and Geodetic Survey, Vine Creek-Frey-Wilmer. It first proceeds northward 40 miles, and then takes a general westerly course to its present terminus near Lenora, Kans. The triangulation consists of a series of well-proportioned quadrilaterals of much larger size than in the other two belts, which was rendered possible by more favorable topographic conditions. The instrument used was a Fauth 8-inch theodolite, No. 362, reading by two micrometers to 2″. Owing to the small errors of closure no figure or station adjustment was necessary. The average error of closure in 60 triangles is 2″·07.

In all of the Kansas triangulation well-proportioned figures with occasional single triangles were used, since the topography rendered it possible to place stations wherever desirable. Angles were read by the method of directions, both singly and combined, in such manner as to give check observations on each angle which entered into the computations. Adjustments by the method of least squares were made in the earlier work, in which less accurate instruments were used. In the later work the closures were so good as to render least-square adjustments unnecessary.

Nearly all of the stations in this work consisted of tripod signals built of rough lumber. Most of the earlier ones were tripods about 16 feet in height supporting an upright 4 by 4 pole and boarded to near the ground, so as to be readily distinguishable at a distance. In the later work the tripod was left more open and a target similar to that used by the Missouri River Commission, consisting of boards covered with white and black cloth and nailed on the pole at right angles to each other, was employed. In some cases, where it was necessary to elevate the instrument, a higher and larger scaffold was built for the support of the observer and within this a smaller tripod was erected for the support of the instrument.

In connection with the triangulation in Kansas a large number of townships and section corners were located usually by the method of directions and distances from the triangulation stations. These locations were made for the purpose of establishing control for the topographic work, which, in the plains country, is largely based on the land surveys.

A list of these corners with their positions is appended.

DESCRIPTIONS AND POSITIONS OF STATIONS.

CHAPEL HILL.

Triangulation station of the U. S. C. & G. S. in Cass Co., Mo., on land belonging to Dr. Joseph Ragsdale, about 400 feet from his house and about one-fourth mile south-southwest from the village of Chapel Hill. Station is in the NE. ¼ of the SE. ¼ of sec. 1, T. 47, R. 29.

Permanent mark: An ale bottle filled with ashes 3 feet below surface. Surface mark, a marble stone with letters U. S. C. S. cut on top. Two witness posts were set 5 feet, respectively, north and south from center of surface mark.

[Latitude, 38° 54′ 52″·14. Longitude, 94° 03′ 27″·27.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thornton	62	04	23	241	57	17	4·2677195
Normal	301	29	31	121	41	34	4·5135400

OWLER.

Triangulation station of the U. S. C. & G. S. in Jackson Co., Mo., on a small hill situated about one-third of a mile west of the house of Mr. J. O. Bowler, the owner of the land, and about 2½ miles southwest of the town of Lee Summit, Jackson Co., Mo. It is in the NW. ¼ of the SW. ¼ of sec. 18, T. 47, R. 31.

Permanent mark: A bottle of ashes 3 feet below surface and three posts for surface marks. The center one has the letters U. S. C. S. cut on top. The witness posts are set 5 feet, respectively, north and south.

[Latitude, 38° 53′ 20″·96. Longitude, 94° 23′ 38″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thornton	294	33	59	114	39	33	4·1498642
Fulton	344	39	22	164	42	38	4·4455354
Independence	175	16	46·3	355	15	57·2	4·357886
Berry	62	31	45	242	25	32	4·2082964

THORNTON.

Triangulation station of the U. S. C. & G. S. in Cass Co., Mo., on land belonging to Mr. Charles T. Thornton, about 4 miles northeast of Pleasant Hill. It is in the NE. ¼ of the NW. ¼ of the NW. ¼ of sec. 4, T. 46, R. 30, about 10 feet south of the line bounding the section on the north. The north line of the section separates Cass Co. from Jackson Co.

Permanent mark: An ale bottle filled with ashes, 2¾ feet below surface. A marble post set flush with the ground, with the letters U. S.

C. S. cut on top, is the surface mark. Two other posts are set, respectively, north and south a distance of 5 feet from center of surface mark.

[Latitude, 38° 50′ 10″·25. Longitude, 94° 14′ 45″·83.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baker	298	20	55	118	27	33	4·2404185
Fulton	14	39	00	194	36	37	4·3370185
Bowler	114	39	33	294	33	59	4·1498642
Chapel Hill	241	57	17	62	04	23	4·2677195

BAKER.

Triangulation station of the U. S. C. & G. S. in Johnson Co., Mo. The station is on the highest part of a prominent hill, about 1 mile north of the town of Kingsville. It is in Johnson Co., Mo., in the S. ½ of the E. ½ of the SE. ¼ of sec. 25, T. 46, R. 29, on land belonging to Mr. Edward Baker, and close to his house.

Permanent mark: An ale bottle filled with ashes, 2½ feet below surface. The surface mark, a marble post set flush with surface, with the letters U. S. C. S. cut on top. Two witness posts are set 5 feet, respectively, north and south of the center of surface mark.

[Latitude, 38° 45′ 41″·91. Longitude, 94° 04′ 11″·78.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Normal	270	08	33	90	21	02	4·4608037
Caldwell	307	51	53	128	03	40	4·5399884
Hutton Mound	22	09	45	202	05	37	4·4063201
Fulton	58	35	02	238	26	03	4·3875027
Thornton	118	27	33	298	20	55	4·2404185

FULTON.

Triangulation station of the U. S. C. & G. S. in Cass Co., Mo., about 2½ miles east-southeast of Harrisonville, Mo., on land belonging to Mr. L. G. Fulton. It is in sec. 2, T. 44, R. 31, 168·5 feet from the northwest corner of the northeast quarter of the section and 71·1 feet south of the fence forming the boundary of Mr. Fulton's farm, separating it from the main road, and 71·5 feet east from a small house.

Permanent mark: An ale bottle filled with ashes, 2½ feet below surface, and over it a marble post 2·1 feet, the letters U. S. C. S. cut on top. Two sandstone posts, each 2·1 feet long, were set 5 feet north and south, respectively.

[Latitude, 38° 38′ 48″·46. Longitude, 94° 18′ 33″·07.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hutton Mound	313	59	26	134	04	16	4·1938480
Baker	238	26	03	58	35	02	4·3875027
Berry	131	54	11	311	44	48	4·4646561
Bowler	164	42	33	344	39	22	4·4455354
Thornton	194	36	37	14	39	00	4·3370185

HUTTON MOUND.

Triangulation station on the U. S. C. & G. S. in Cass Co., Mo. This station is on a hill, locally known as "Big Mound," belonging to Mr. Thomas Hutton, about five-eighths of a mile east of his house, and about 14 miles southeast of Harrisonville, in the NE. ¼ of the NW. ¼ of the SE. ¼ of sec. 1, T. 43, R. 30.

Permanent mark: An ale bottle filled with ashes, 2½ feet below surface, over this a stone post, set flush with surface, with the letters U. S. C. S. cut on top. Two other posts were set 5 feet, respectively, north and south of station.

[Latitude, 38° 32′ 56″·24. Longitude, 94° 10′ 48″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baker	202	05	37	22	09	45	4·4063201
Caldwell	260	20	22	86	36	14	4·5689069
Fulton	134	04	16	313	59	26	4·1938480

NORTH MOUND.

Triangulation station in Bates Co., Kans., on what is locally known as North Mound, in the SE. ¼ of the NW. ¼ of sec. 19, T. 40, R. 30, about 7 miles northeast of Butler and 6 miles southeast of Adrian.

Permanent mark: Stone set in the ground, marked with cross and U. S. G. S.

Latitude, 38° 20′ 51″·45. Longitude, 94° 17′ 13″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Long Mound	122	03	05·6	301	50	51·47	4·528461
Wooded Mound	87	01	37·1	266	49	11·02	4·466131

LONG MOUND.

In Miami Co., Kans., on what is locally known as Long Mound, about 12 miles south of Louisburg and one-eighth mile west of the State line, in the SE. ¼ of the SW. ¼ of sec. 2, T. 18, R. 25.

Permanent mark: Stone sunk 18 inches below surface; top flush with surface and marked with cross and U. S. G. S.

[Latitude, 38° 30′ 30″·94. Longitude, 94° 36′ 54″·35.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wooded Mound	1	32	38·97	181	32	25·59	4·288793
Ellison	65	02	13·67	244	59	25·75	3·858096
North Mound	301	50	51·47	122	03	05·6	4·528461

WOODED MOUND.

In Linn Co., Kans., about 8 miles east of La Cygne and 3 miles so west of West Point, in the SW. ¼ of sec. 2, T. 20, R. 25, one-fourth west of State line.

Permanent mark: Stone sunk 18 inches in the ground, marked cross and U. S. G. S.

[Latitude, 38° 20′ 00″·55. Longitude, 94° 37′ 15″·90.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ellison	159	50	51·79	339	48	17·59	4·242093
McCook	93	11	51·39	272	59	57·93	4·446725
North Mound.....	266	49	11·02	87	01	37·1	4·466631
Long Mound......	181	32	25·59	1	32	38·97	4·288793

ELLISON.

In Miami Co., Kans., about 3 miles northeast of Lancaster, i SE. ¼ of the SW. ¼ of sec. 18, T. 18, R. 25.

Permanent mark: Stone, top flush with surface and marked wi cross and U. S. G. S.

[Latitude, 38° 28′ 52″·14. Longitude, 94° 41′ 24″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Insane Asylum...	99	39	06·00	279	29	48·15	4·342576
McCook	55	51	47·99	235	42	27·19	4·422602
Long Mound	244	59	25·75	65	02	13·67	3·858096
Wooded Mound...	339	48	17·59	159	50	51·79	4·242093

M^c^COOK.

In Linn Co., Kans., about 9 miles west of La Cygne and 10 miles s of Osawatomie, on land owned by Mr. McCook, in the SW. ¼ of SE. ¼ of sec. 35, T. 19, R. 22, 1,375 feet west and 35 feet north o southeast corner of the section.

Permanent mark: Stone sunk 18 inches in the ground, top flush the surface, marked with cross and U. S. G. S.

[Latitude, 38° 20′ 49″·60. Longitude, 94° 56′ 26″·04.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
White	118	08	59·0	298	04	22·28	4·088778
Insane Asylum...	180	28	43·2	0	28	47·17	4·268103
Wooded Mound...	272	59	57·93	93	11	51·39	4·446725
Ellison	235	42	27·19	55	51	47·99	4·422602

INSANE ASYLUM.

In Miami Co., Kans., at Osawatomie. Station in main cupola of building. In sec. 2, T. 18, R. 22.

Permanent mark: Center of cupola.

[Latitude, 38° 30′ 50″·86. Longitude, 94° 56′ 19″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
White	40	42	40·37	220	37	59·16	4·225875
Wilton	88	45	02·57	268	37	15·33	4·259700
Ellison	279	29	48·15	99	39	06·00	4·342576
McCook	0	28	47·17	180	28	43·20	4·268103

WHITE.

In Franklin Co., Kans., near corner of Franklin, Miami, Linn, and Anderson counties, on land owned by J. H. White, and is in the SW. ¼ of the NW. ¼ of sec. 14, T. 19, R. 21, about 5½ miles northeast of Greeley and 5 miles southeast of Lane.

Permanent mark: Stone sunk 18 inches in the ground, top flush with the surface, and marked with a cross and U. S. G. S.

[Latitude, 38° 23′ 57″·06. Longitude, 95° 03′ 51″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wilton	149	39	39·96	329	36	34·5	4·155446
Dutch College	74	54	35·7	254	48	55·2	4·139510
Insane Asylum	220	37	59·16	40	42	40·37	4·225875
McCook	298	04	22·28	118	08	59·0	4·088773

WILTON.

In Franklin Co., Kans., 8 miles east of Princeton, and about 8 miles northwest of Lane. Station is center of the chimney of Mrs. Wilton's house in the SE. ¼ of the SW. ¼ of sec. 1, T. 18, R. 20.

Permanent mark: Chimney.

[Latitude, 38° 30′ 37″·34. Longitude, 95° 08′ 50″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dutch College	20	51	30·30	200	48	54·80	4·231921
Loamas	77	09	25·30	256	57	48·28	4·444930
White	329	36	34·51	149	39	39·96	4·155446
Insane Asylum	268	37	15·33	88	45	02·57	4·259700

DUTCH COLLEGE.

In Anderson Co., Kans., about 1 mile southeast of Scipio, on the Kansas Southern Railway, about 6 miles north-northeast of Garnett, in the cupola of the Dutch Catholic College. In the NE. ¼ of the S of sec. 29, T. 19, R. 20.

Permanent mark: Center of cupola.

[Latitude, 38° 22′ 00″·30. Longitude, 95° 13′ 00″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Loamas	114	46	01·80	294	37	01·31	4·366056
Rock Mound	82	44	26·50	262	33	10·07	4·426359
White	254	48	55·2	74	54	35·7	4·139510
Wilton	200	48	54·80	20	51	30·30	4·231921

LOAMAS.

In Franklin Co., Kans., about 1½ miles south of Williamsburg land owned by Mr. Loamas, in the center of the SE. ¼ of sec. 30, T R. 18.

Permanent mark: Stone sunk in the ground 18 inches and ma with a cross and U. S. G. S.

[Latitude, 38° 27′ 15″·04. Longitude, 95° 27′ 30″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rock Mound	22	10	56·01	202	08	39·33	4·151281
Duval	62	12	45·14	242	06	06·46	4·245590
Roky	107	49	11·34	287	41	12·50	4·291917
Dutch College	294	37	01·31	114	46	01·80	4·366056
Wilton	256	57	48·28	77	09	25·30	4·444930

ROCK MOUND.

In Anderson Co., Kans., about 7 miles southeast of Waverly, o north end of a mound in the SE. ¼ of sec. 3, T. 20, R. 17.

Permanent mark: Stone sunk 18 inches in the ground, the top flush with surface, marked with a cross and U. S. G. S.

[Latitude, 38° 20′ 09″·52. Longitude, 95° 31′ 10″·36.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duval	115	37	23·20	295	33	01·70	4·054732
Dutch College	262	33	10·07	82	44	26·50	4·426350
Loamas	202	08	39·33	22	10	56·01	4·151281

DUVAL.

In Coffey Co., Kans., about 3 miles southwest of Waverly. Stati the center of the chimney of Duval's house, in the SW. ¼ of sec. 2 19, R. 16.

Permanent mark: Chimney.

[Latitude, 38° 22′ 48″·40. Longitude, 95° 38″ ·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Roky	167	40	56·26	347	39	36·73	4·162216
Fillmore	125	40	10·36	305	35	03·40	4·168496
Allen	96	36	14·90	276	31	52·96	4·013078
Rock Mound	295	33	01·70	115	37	23·20	4·054732
Loamas	242	06	06·46	62	12	45·14	4·245590

ROKY.

In Osage Co., Kans., 2 miles west of Melverne, on land owned by Mr. Jacob Roky, about 1,000 feet northwest from his house, in the northwest corner of sec. 8, T. 18, R. 16.

Permanent mark: Stone sunk 18 inches in the ground and the top flush with surface, marked with a cross and U. S. G. S.

[Latitude, 38° 30′ 28″·72. Longitude, 95° 40′ 19″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Allen	38	43	55·04	208	40	52·28	4·171384
Fillmore	57	43	57·51	237	40	09·78	4·020929
Plumb	90	27	18·28	270	13	59·09	4·492761
Loamas	287	41	12·50	107	49	11·84	4·291917
Duval	347	39	36·73	167	40	56·26	4·162216

ALLEN.

In Coffey Co., Kans., about 6 miles southeast from Lebo, on land owned by Clinton Allen, in the NE. ¼ of the NW. ¼ of sec. 21, T. 19, R. 15, about 300 feet south of section line and 500 feet west of one-half section line.

Permanent mark: Stone sunk 18 inches in the ground, top flush with surface, and marked with a cross and U. S. G. S.

[Latitude, 38° 23′ 26″·62. Longitude, 95° 45′ 13″·55.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Calvert	100	43	54·50	280	36	37·71	4·239563
Duval	276	31	52·96	96	36	40·90	4·013078
Roky	208	40	52·28	28	43	55·04	4·171384
Fillmore	166	43	54·34	346	43	09·57	3·881425

FILLMORE.

In Osage Co., Kans., about 5 miles northeast of Lebo and one-half mile south of the Kansas Southern Railway, in sec. 29, T. 18, R. 15, 200 feet north of road on section line. Station is chimney of Fillmore's house.

Permanent mark: Chimney.

[Latitude, 38° 27′ 26″·86. Longitude, 95° 46′ 25″·60.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	′	°	′	″	*Meters.*
Allen	346	43	09·57	166	43	54·34	3·881425
Calvert	74	44	05·80	254	37	33·47	4·200554
Plumb	104	40	51·89	284	31	20·89	4·361402
Duval	305	35	03·40	125	40	10·36	4·168496
Roky	237	40	09·78	57	43	57·51	4·020929

CALVERT.

In Lyon Co., Kans., 5 miles due west of Lebo and 13 miles ea Emporia, on land owned by Mr. Calvert. About 250 feet south of his house, in the NW. ¼ of the NW. ¼ of sec. 11, T. 19, R. 13.

Permanent mark: Stone sunk 18 inches in the ground, marked a cross and U. S. G. S.

[Latitude, 38° 25′ 10″·89. Longitude, 95° 56′ 56″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Plumb	145	12	11·14	325	09	12·91	4·085110
Chicago Mound	54	48	59·01	234	44	30·84	4·103214
Allen	280	36	37·71	100	43	54·50	4·239563
Fillmore	254	37	33·47	74	44	05·80	4·200554

PLUMB.

In Lyon Co., Kans., on land owned by Senator Plumb, about 12 m northeast of Emporia and 3 miles southwest of Reading, in the S of sec. 1, T. 18, R. 12, 546 feet north and 1,518 feet west from the so east corner of the section.

Permanent mark: Stone set 18 inches in the ground. Top flush the surface and marked with a cross and U. S. G. S.

[Latitude, 38° 30′ 34″·76. Longitude, 96° 01′ 43″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chicago Mound	11	28	24·04	191	26	53·71	4·248911
Stubbs	82	16	14·70	262	06	01·70	4·381832
Roky	270	13	59·09	90	27	18·28	4·492761
Fillmore	284	31	20·89	104	40	51·89	4·361402

CHICAGO MOUND.

In Lyon Co., Kans., about 9 miles southeast of Emporia, in NW. ¼ of the SE. ¼ of sec. 34, T. 19, R. 12. About 5 miles southw of Neosho Rapids, on the Missouri, Kansas and Texas Railway.

Permanent mark: Stone sunk 18 inches in the ground. Top flush with surface, marked with a cross and U. S. G. S.

[Latitude, 38° 21′ 10″·91. Longitude, 96° 04′ 08″·52.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Jacobs Mound....	82	06	35·10	261	54	08·90	4·469905
Stubbs	124	47	16·66	304	38	35·00	4·394046
Plumb.............	191	26	53·71	11	28	24·04	4·248911

STUBBS.

In Lyon Co., Kans., about 5 miles southwest of Americus, in the SE. ¼ of the SE. ¼ of sec. 16, R. 9, 406 feet east and 296 feet north from the southwest corner of the section.

Permanent mark: Stone sunk 18 inches in the ground; top flush with the surface, marked with a cross and U. S. G. S.

[Latitude, 38° 28′ 48″·56. Longitude, 96° 18′ 06″·04.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baker	90	31	16·10	270	24	54·51	4·172151
Jacobs Mound....	25	52	28·90	205	48	43·09	4·306163
Chicago Mound...	304	38	35·00	124	47	16·66	4·394046
Plumb.............	262	06	01·70	82	16	14·70	4·381832

JACOBS MOUND.

In Chase Co., Kans., in the SE. ¼ of the NW. ¼ of sec. 15, T. 20., R. 9, about 6 miles south of Safford, on Atchison, Topeka and Santa Fe Railway.

Permanent mark: Stone sunk 18 inches in the ground, top flush with surface, marked with a cross and U. S. G. S.

[Latitude, 38° 18′ 57″·82. Longitude, 96° 24′ 11″·58.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Baker	161	44	05·89	341	41	30·80	4·285792
Cattle Ranch	126	37	26·57	306	29	27·47	4·367691
Tedro..............	93	22	17·56	273	13	57·41	4·292743
Messer	78	11	33·18	.....	.....	.....	4·393927
Stubbs	205	48	43·09	25	52	28·90	4·306163
Chicago Mound...	261	54	08·90	82	06	35·10	4·469905

BAKER.

In Chase Co., Kans., about 8 miles northwest of Safford, in the SW. ¼ of the SE. ¼ of sec. 13, T. 18, R. 8, on a mound on land owned by H. L. Baker, and about three-fourths of a mile east of his house.

Permanent mark: Stone sunk 18 inches in the ground, top with surface, marked with a cross and U. S. G. S.

[Latitude, 38° 28′ 52″·41. Longitude, 96° 28′ 21″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cattle Ranch	70	41	11·61	250	35	46·94	4·127547
Tedro	38	11	07·51	218	05	21·67	4·339938
Jacobs Mound	341	41	30·80	161	44	05·89	4·285792
Stubbs	270	24	54·51	90	31	16·10	4·172151

CATTLE RANCH.

In Chase Co., Kans., about 5 miles northeast of Elmdale and ab miles northwest of Strong, on a ranch owned by the Western C Company, in the SE. ¼ of the SE. ¼ of sec. 35, T. 18, R. 7.

Permanent mark: Stone sunk 2 feet in the ground, top flush surface, and marked with a cross and U. S. G. S.

[Latitude, 38° 26′ 28″·24. Longitude, 96° 37′ 03″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tedro	3	47	07·30	183	46	45·72	4·160752
Weichaus	49	44	00·17	229	39	43·59	4·118647
Baker	250	35	46·94	70	41	11·61	4·127547
Jacobs Mound	306	29	27·49	126	37	26·57	4·367691

TEDRO.

In Chase Co., Kans., about 5 miles south of Elmdale, on the Atch Topeka and Santa Fe Railway, in the NE. ¼ of the SW. ¼ of sec. 20, R. 7, on an elevation about one-half mile southwest of the hou Reuben Tedro.

Permanent mark: Stone sunk 24 inches in the ground, top flush with the surface, marked with a cross and U. S. G. S.

[Latitude, 38° 19′ 34″·46. Longitude, 96° 37′ 38″·01.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Weichaus	114	54	11·70	294	50	17·00	4·005410
Messer	36	41	00·71	216	39	02·34	3·890538
Cattle Ranch	183	46	45·72	3	47	07·30	4·106752
Baker	218	05	21·67	38	11	07·51	4·339938
Jacobs Mound	273	13	57·41	93	22	17·56	4·292743

MESSER.

In Chase Co., Kans., near the center of sec. 32, T. 20, R. 7, o elevation about 150 yards west of —— Messer's house. It is abou miles southwest of Cottonwood Falls and about 5 miles east-south of Clements, on the Atchison, Topeka and Santa Fe Railway.

Permanent mark: Earthen jar filled with ashes, 18 inches below surface, and over it a stone marked with a cross and U. S. G. S.

[Latitude, 38° 16′ 12″·26. Longitude, 96° 40′ 49″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Weichaus	156	34	23·69	336	32	27·57	4·058296
McLane	89	24	27·52	269	15	43·02	4·313610
Tedro	216	39	02·34	36	41	00·70	3·890538
Jacobs Mound				78	11	33·18	4·393927

WEICHAUS.

In Chase Co., Kans., about 5 miles west of Elmdale, on the Atchison, Topeka and Santa Fe Railway. It is in the SW. ¼ of the SE. ¼ of sec. 26, T. 19, R. 6. On southern crest of ridge, west of Weichaus's house, 1,500 feet west and 195·5 feet north of the southeast corner of section 26.

Permanent mark: Bottle of ashes buried 2 feet below surface, over which is a stone marked with a cross and U. S. G. S.

[Latitude, 38° 21′ 52″·57. Longitude, 96° 43′ 56″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
McLane	56	14	39·74	236	07	50·80	4·285218
Tedro	294	50	17·00	114	54	11·70	4·005410
Cattle Ranch	229	39	43·59	49	44	00·17	4·118647

NEWHALL.

In Chase Co., Kans., about 6 or 8 miles southeast of the town of Florence, in yard of house owned by Mr. Newhall, and no surrounding objects except a few scattering trees northwest of the signal on flat-topped ridge.

Permanent mark: None.

[Latitude, 38° 10′ 30″·13. Longitude, 96° 53′ 46″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Herron	123	22	29·2	303	17	46·8	4·123743
St. John	75	22	58·5	255	19	08·9	3·970855
McLane	170	49	23·1	350	48	41·6	4·0093919

McLANE.

In Chase Co., Kans., in NE. ¼ of SE. ¼ of sec. 31, R. 5, T. 20, on land owned by Mr. McLane, on high ground about one-half mile northwest from house. Signal, lumber tripod.

Permanent mark: Stone buried flush with surface of ground marked U. S. G. S. +, and later large wooden plug was placed.

[Latitude, 38° 15′ 57″·32. Longitude, 96° 54′ 53″·86.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Weichaus	236	07	50·80	56	14	39·74	4·2852176
Messer	269	15	43·02	89	24	27·52	4·3136100
Herron	73	40	26·60	253	36	25·40	3·9944218
Newhall	350	48	41·60	170	49	23·10	4·0093919

HERRON.

In Marion Co., Kans., on a small knoll 5 miles south of Mario public road a few hundred feet south of section corner.

Permanent mark: None.

[Latitude, 38° 14′ 27″·16. Longitude, 97° 01′ 23″·46.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dunkard	81	58	22·1	261	52	58·7	4·108467
St. John	347	55	32·7	167	56	25·2	3·995216
Mc Lane	253	36	25·4	73	40	26·6	3·9944218
Newhall	303	17	46·8	123	22	29·2	4·123743

ST. JOHN.

In Marion Co., Kans., on rolling ridge about 7 miles south of Herron, in a large field at present used as a cow pasture.

Permanent mark: None.

[Latitude, 38° 09′ 13″·46. Longitude, 96° 59′ 58″·46.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dunkard	118	04	31·1	297	58	15·5	4·223999
Newt	75	24	04·7	255	16	40·2	4·258168
Herron	167	56	25·2	347	55	32·7	3·995216

DUNKARD.

In Marion Co., Kans., in SW. ¼ of sec. 13, T. 21, R. 2 E., 38 east and 2,407 feet north of the southwest corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 13′ 28″·69. Longitude, 97° 10′ 06″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Walton	29	27	27·3	209	25	01·4	4·067905
Bennett	58	05	54·2	238	02	13·3	4·010395
St. John	297	58	15·5	118	04	31·1	4·223999

NEWT.

In Marion Co., Kans., on ridge about 3 miles east of the town of Walton. No close objects of prominence.

Permanent mark: None.

[Latitude, 38° 06′ 44″·73. Longitude, 97° 11′ 58″·24.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Walton	126	59	50·2	306	58	33·7	3·577161
Township corner	63	00	53·4	242	58	32·4	3·795644
St. John	255	16	40·2	75	24	04·7	4·268168

WALTON.

In Harvey Co., Kans., nearly a mile northeast of the town of Walton, and about 1,000 feet southeast of the Atchison, Topeka and Santa Fe Railroad.

Permanent mark: None.

[Latitude, 38° 07′ 58″·43. Longitude, 97° 14′ 02″·11.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bennett	148	15	26·7	328	14	11·0	3·748530
Township corner	26	30	32·4	206	29	27·9	3·756524
Dunkard	209	25	01·4	29	27	27·3	4·067905
Newt	306	68	33·7	126	59	50·2	3·577161

TOWNSHIP CORNER.

In Harvey Co., Kans., in southeast corner of sec. 36, T. 22, R. 1 E., 43 feet west and 235 feet north of township corner, townships 22 and 23, Rs. 1 and 2 E.

Permanent mark: Township corner.

[Latitude, 38° 05′ 12″·73. Longitude, 97° 15′ 46″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Royer	144	58	22·5	324	55	40	4·047786
Newton	59	58	48·1	239	55	47·2	3·917087
Bennett	177	39	38·5	357	39	23·3	3·994874
Walton	206	29	27·9	26	30	32·4	3·756524
Newt	242	58	32·4	63	00	53·4	3·795644

BENNETT.

In Marion Co., Kans., southeast corner of sec. 36, T. 21, R. 1 E., 546 feet north and 1,461 feet west of the southeast corner of the section, and about 75 feet northeast of Bennett's residence.

Permanent mark: The section corner.

[Latitude, 38° 10′ 32″·99. Longitude, 97° 16′ 03″·24.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Royer	83	01	33·7	262	59	01·2	3·781598
Township corner	357	39	23·3	177	39	33·5	3·994874
Dunkard	238	02	13·3	58	05	54·2	4·010395
Walton	328	14	11·9	148	15	26·7	3·748530

ROYER.

In Harvey Co., Kans., on NE. ¼ of sec. 5, T. 22, R. 1 E., 12 feet and 1,564 feet south of the northeast corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 10′ 09″·10. Longitude, 97° 20′ 09″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hesston	69	18	04·2	249	14	41·1	3·932405
Newton	3	10	35·3	183	10	16·7	4·123682
Bennett	262	59	01·2	83	01	33·7	3·781598
Township corner	324	55	40	144	58	22·5	4·047736

NEWTON.

In the city of Newton, Harvey Co., Kans., in NW. ¼ of sec. 16, R. 1 E., 85 feet north and 109 feet west of the center of the se Center of the cupola of the opera house.

Permanent mark: Same.

[Latitude, 38° 02′ 58″·56. Longitude, 97° 20′ 40″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hesston	144	38	52·3	324	35	48·1	4·099182
Ruth	94	19	27·2	274	13	54·3	4·120651
Royer	183	10	16·7	3	10	35·3	4·123682
Township corner	239	55	47·2	59	58	48·1	3·917087

HESSTON.

In Harvey Co., Kans., in NE. ¼ of sec. 16, T. 22, R. 1 W., 41 west and 869 feet south of the northeast corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 08′ 30″·86. Longitude, 97° 25′ 38″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black Kettle	93	13	05·6	273	08	06·4	4·072347
Ruth	32	26	46·0	212	24	17·0	4·040248
Royer	249	14	41·1	69	18	04·2	3·932405
Newton	324	35	48·1	144	38	52·3	4·099182

RUTH.

In **Harvey** Co., Kans., near the center of the NE. ¼ of the NW. ¼ of sec. 13, T. 23, R. 2 W.

Permanent mark: The section corner.

[Latitude, 38° 03′ 30″·50. Longitude, 97° 29′ 40″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black Kettle......	149	11	11·5	329	08	41·6	4·062483
Dwarf............	96	27	52·2	276	21	35·4	4·175894
Hesston..........	212	24	17·0	32	26	46·0	4·040248
Newton...........	274	13	54·3	94	19	27·2	4·120651

BLACK KETTLE.

In **Harvey** Co., Kans., in SE. ¼ of sec. 8, T. 22, R. 2 W., 1,186 feet north and 2,063 feet west of the southeast corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 08′ 52″·10. Longitude, 97° 33′ 43″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Leslie............	88	56	28·9	268	48	05·9	4·297218
Dwarf............	47	27	49·9	227	24	02·6	4·085725
Hesston..........	273	08	06·4	93	13	05·6	4·072347
Ruth.............	329	08	41·6	149	11	11·5	4·062483

DWARF.

In **Harvey** Co., Kans., in SW. quarter of sec. 4, T. 23, R. 3 W., 72 feet east and 640 feet north of the southwest corner of the section, on a sand hill.

Permanent mark: The section corner.

[Latitude, 38° 04′ 24″·78. Longitude, 97° 39′ 51″·21.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Leslie............	125	54	10·6	305	49	35·5	4·127157
Sheep Ranch......	88	03	09·5	267	57	41·7	4·112791
Black Kettle......	227	24	02·6	47	27	49·9	4·085725
Ruth.............	276	21	35·4	96	27	52·2	4·175894

LESLIE.

In **Reno** Co., Kans., in SW. ¼ of sec. 8, T. 22, R. 4 W., 21 feet north and 1,510 feet east of the southwest corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 08′ 39″·43. Longitude, 97° 47′ 17″·01.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Sand Hill	97 31 59·3	277 26 07·1	4·146108
Sheep Ranch	14 08 27·9	194 07 34·9	3·932558
Black Kettle	268 48 05·9	88 56 28·9	4·297218
Dwarf	305 49 35·5	125 54 10·6	4·127157

SHEEP RANCH.

In Reno Co., Kans., in the NE. corner of sec. 13, T. 23, R. 5 W feet west and 4,565 feet north of the southeast corner of the se on a sand hill on the west side of the road.

Permanent mark: The section corner.

[Latitude, 38° 04′ 10″·15. Longitude, 97° 48′ 42″·82.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Sand Hill	130 40 59·9	310 36 01·0	4·191636
Two	85 28 11·5	265 20 20·1	4·271868
Leslie	194 07 34·9	14 08 27·9	3·932558
Dwarf	267 57 41·7	88 03 09·5	4·112791

SAND HILL.

In Reno Co., Kans., in the SW. ¼ of the SE. ¼ of sec. 2, T. 22, R. 6 or 8 miles north and a little west of Hutchinson, on prominent dune.

Permanent rank: None.

[Latitude, 38° 09′ 38″·57. Longitude, 97° 56′ 47″·08.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Lyons	137 24 12·2	317 16 48·6	4·410211
Sterling	106 21 51·1	286 12 11·6	4·375840
Leslie	277 26 07·1	97 31 59·3	4·146108
Sheep Ranch	310 36 01·0	130 40 59·9	4·191636
Two	30 28 00·9	210 25 07·8	4·129792

TWO.

In Reno Co., Kans., in NW. ¼ of sec. 18, T. 23, R. 7 W., 273 feet and 1,776 feet east of the northwest corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 03′ 21″·56. Longitude, 98° 01′ 27″·49.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Sand Hill	210 25 07·8	30 28 00·9	4·129792
Sterling	138 52 55·4	318 46 09·8	4·385499
Sheep Ranch	265 20 20·1	85 28 11·5	4·271868

LYONS.

In Rice Co., Kans., in the NE. ¼ of sec. 12, T. 20, R. 8 W., 19 feet west and 553 feet south of the northeast corner of the section, several miles east of Lyons.

Permanent mark: The section corner.

[Latitude, 38° 19′ 51″·93. Longitude, 98° 08′ 43″·70.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Millet	79	87	01·7	259	29	10·8	4·273315
Sterling	23	39	17·3	203	37	00·7	4·126189
Sand Hill	317	16	48·6	137	24	12·2	4·410211

STERLING.

In Rice Co., Kans., in SW. ¼ of sec. 16, T. 21, R. 8 W., 286 feet west and 1,464 feet north of the south quarter corner of the section, being center of cupola of Sterling University.

Permanent mark: Same.

[Latitude, 38° 13′ 14″·64. Longitude, 98° 12′ 24″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Millet	124	04	17·6	303	58	43·8	4·198967
Drifting Sand	73	01	47·5	252	52	51·5	4·343664
Lyons	203	37	00·7	23	39	17·3	4·126189
Sand Hill	286	12	11·6	106	21	51·1	4·875840
Two	318	46	09·8	138	52	55·4	4·385499

MILLET.

In Rice Co., Kans., in the SW. ¼ of the NE. ¼ of sec. 18, T. 20, R. 9 W. On north side of the public road.

Permanent mark: The section corner.

[Latitude, 38° 18′ 01″·57. Longitude, 98° 21′ 23″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Raymond	79	15	40·1	259	13	55·4	3·620867
Drifting Sand	27	31	50·9	207	28	28·0	4·237176
Sterling	303	58	43·8	124	04	17·6	4·198967
Lyons	259	29	10·8	79	37	01·7	4·273315

RAYMOND.

In Rice Co., Kans., in the SW. ¼ of sec. 23, T. 20, R. 10 W., 668 feet east and 1,336 feet south of the west quarter corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 17′ 36″·29. Longitude, 98° 24′ 12″·15.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pasture	111	41	55·3	291	32	23.8	4·381532
County Line	77	30	37·1	257	23	39·4	4·225033
Drifting Sand	14	54	28·5	194	52	50·1	4·177247
Millet	259	13	55·4	79	15	40·1	3·620867

DRIFTING SAND.

In Reno Co., Kans., in SW. ¼ of sec. 8, T. 22, R. 10 W., 1,228 feet east and 3,760 feet south of the northwest corner of the section, on a prominent knoll.

Permanent mark: The section corner.

[Latitude, 38° 09′ 44″·89. Longitude, 98° 26′ 51″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Raymond	194	52	50·1	14	54	28·5	4·177247
County Line	131	01	00·3	310	55	41·6	4·220210
Millet	207	28	28·0	27	31	50·9	4·237176
Sterling	252	52	51·5	73	01	47·5	4·343664

COUNTY LINE.

In Kansas, on county line between Stafford and Barton counties, 431 feet west of the southeast corner of sec. 36, T. 20, R. 12 W.

Permanent mark: The section corner.

[Latitude, 38° 15′ 37″·99. Longitude, 98° 35′ 26″·38.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pasture	154	23	26·6	334	20	53·3	4·142485
Mound	79	12	30·0	259	05	18·0	4·237523
Drifting Sand	310	55	41·6	131	01	00·3	4·220210
Raymond	257	23	39·4	77	30	37·1	4·225033

PASTURE.

In Barton Co., Kans., in the NE. ¼ of sec. 28, T. 19, R. 12 W., 963 feet south and 1,040 feet east of the northwest corner of the section. Several miles east of Great Bend, and 1 mile north of the Atchison, Topeka and Santa Fe Railroad, in a large cow pasture.

Permanent mark: The section corner.

[Latitude, 38° 22′ 23″·95. Longitude, 98° 39′ 33″·57.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cactus	100	51	49·0	280	44	01·4	4·269639
Mound	34	48	51·4	214	44	12·1	4·283283
Raymond	291	32	23·8	111	41	55·3	4·381532
County Line	334	20	53·3	154	23	26·6	4·142485

MOUND.

In Stafford Co., Kans., in the NE. ¼ of sec. 18, T. 21, R. 13 W., 254 feet west and 196 feet south of the northeast corner of the section. On a small mound.

Permanent mark: The section corner.

[Latitude, 38° 13′ 52″·48. Longitude, 98° 47′ 04″·24.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pawnee	110	29	04·1	290	20	10·9	4·348960
Ackerman	24	04	46·3	204	02	29·6	4·120549
Cactus	159	08	43·6	339	05	36·1	4·314068
Pasture	214	44	12·1	34	48	51·4	4·283283
County line	259	05	18·0	79	12	30·0	4·237523

ACKERMAN.

In Stafford Co., Kans., in the SE. ¼ of sec. 22, T. 22, R. 14 W., 241 feet east and 273 feet south of the center of section 22.

Permanent mark: The section corner.

[Latitude, 38° 07′ 21″·59. Longitude, 98° 50′ 45″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pawnee	141	56	07·7	321	49	31·9	4·401743
Larned	93	12	32·7	273	04	26·4	4·283578
Mound	204	02	29·6	24	04	46·3	4·120549

CACTUS.

In Barton Co., in the NE. ¼ of sec. 16, T. 19, R. 14 W., 21 feet south and 828 feet west of the northwest corner of the section, on public road northwest of Great Bend.

Permanent mark: The section corner.

[Latitude, 38° 24′ 17″·00. Longitude, 98° 52′ 06″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pawnee	49	50	13·10	229	44	26·50	4·249488
Mound	339	05	36·10	159	08	43·60	4·314068
Pasture	280	44	00·14	100	51	49·00	4·269639

PAWNEE.

In Barton Co., Kans., in the SW. ¼ of sec. 19, T. 20, R. 15 W., 533 feet west and 1,027 feet south of the north quarter corner of the section on highest part of rolling ridge.

Permanent mark: The section corner.

[Latitude, 38° 18′ 05″·09. Longitude, 99° 01′ 25″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dugout	74	21	27·7	254	13	49·5	4·271204
Larned	10	50	16·5	190	48	45·1	4·281684
Mound	290	20	10·9	110	29	04·1	4·348960
Cactus	229	44	26·5	49	50	13·1	4·249488
Ackerman	321	49	31·9	141	56	07·7	4·401743

LARNED.

In Pawnee Co., Kans., in the SE. ¼ of sec. 15, T. 22, R. 16 W., 64 north and 2,065 feet west of the southeast corner of the section, s miles south of Larned, on the highest mound in the vicinity.

Permanent mark: The section corner.

[Latitude, 38° 07′ 55″·74. Longitude, 99° 03′ 53″·94.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dugout	133	41	20·0	313	35	14·0	4·298871
Garfield	79	49	03·4	259	42	50·7	4·174463
Pawnee	190	48	45·1	10	50	16·5	4·281684
Ackerman	273	04	26·4	93	12	32·7	4·283578

DUGOUT.

In Pawnee Co., Kans., in the NW. ¼ of sec. 6, T. 21, R. 17 W., 1,36 east, and 1,723 feet south of the southwest corner of sec. 21, T. 17. On highest ground near ruins of a sod house.

Permanent mark: The section corner.

[Latitude, 38° 15′ 21″·16. Longitude, 99° 13′ 44″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Quarry	89	55	03·0	269	47	53·5	4·227045
Garfield	1	00	38·4	181	00	31·1	4·214611
Pawnee	254	13	49·5	74	21	27·7	4·271204
Larned	313	35	14·0	133	41	20·0	4·298871

GARFIELD.

In Pawnee Co., Kans., in the SW. ¼ of sec. 30, T. 22, R. 17 W., 2 south and 2,047 feet east of the west quarter corner of the se About 2 miles north of Garfield and one-fourth of a mile east of

Permanent mark: The section corner.

[Latitude, 38° 06′ 29″·63. Longitude, 99° 13′ 56″·68.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Quarry	134	37	34·7	314	30	33·2	4·367248
Burdett	98	36	40·4	278	25	03·0	4·444370
Dugout	181	00	31·1	1	00	38·4	4·214611
Larned	259	42	50·7	79	49	03·4	4·174463

QUARRY.

In Pawnee Co., Kans., in NW. ¼ of sec. 5, T. 21, R. 19 W., 635 feet east and 2,275 feet south of the northwest corner of the section.

Permanent mark: Section corner.

[Latitude, 38° 15′ 19″·81. Longitude, 99° 25′ 18″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Frank	78	05	27·6	257	54	20·7	4·428074
Burdett	41	44	26·2	221	39	49·3	4·214248
Dugout	269	47	53·5	89	55	03·0	4·227045
Garfield	314	30	33·2	134	37	34·7	4·367248

BURDETT.

In Pawnee Co., Kans., in the NW. ¼ of sec. 17, T. 22, R. 20 W., 15 feet south and 1,326 feet east of the northwest corner of the section, on public road on ridge crossing it.

Permanent mark: The section corner.

[Latitude, 38° 08′ 43″·23. Longitude, 99° 32′ 46″·31.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Frank	113	31	15·0	293	24	45·7	4·223071
Last Chance	28	23	13·8	208	21	06·3	4·025109
Garfield	278	25	03·0	98	36	40·4	4·444370
Quarry	221	39	49·3	41	44	26·2	4·214248

LAST CHANCE.

In Hodgeman Co., Kans., in SW. ¼ of sec. 14, T. 23, R. 21 W., 1,366 feet north and 397 feet east of the southwest corner of the section, a few hundred feet east of a stone dugout.

Permanent mark: The section corner.

[Latitude, 38° 03′ 40″·85. Longitude, 99° 36′ 12″·94.]

To stations.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Orwell	76	43	25·1	256	35	58·9	4·258737
Cheese factory	45	08	58·8	225	07	26·6	3·711399
Frank	147	12	36·0	327	08	14·7	4·279089
Burdett	208	21	06·3	28	23	13·8	4·025109

CHEESE FACTORY.

In Hodgeman Co., Kans., in SE. ¼ of sec. 29, T. 21, R. 23 W., 1,000 west and 14·5 feet north of the southeast corner of the sectio mile southwest of the cheese factory on public road.

Permanent mark: The section corner.

[Latitude, 38° 01′ 43″·15. Longitude, 99° 38′ 42″·51.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
First View	73	44	52·6	253	37	55·4	4·236135
Spearville	25	46	00·3	205	42	02·0	4·338358
Orwell	87	46	30·0	267	40	36·1	4·146807
Last Chance	225	07	26·6	45	08	58·8	3·711399

FRANK.

In Hodgeman Co., Kans., in the SE. ¼ of sec. 22, T. 21, R. 22 W., feet north and 1,440 feet west of the southeast corner of the sectio

Permanent mark: The section corner.

[Latitude, 38° 12′ 19″·09. Longitude, 99° 43′ 16″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Orwell	19	59	42·8	199	56	37·2	4·331513
Last Chance	327	08	14·7	147	12	36·0	4·279089
Quarry	257	54	20·7	78	05	27·6	4·428074
Burdett	293	24	45·7	113	31	15·0	4·223071

SPEARVILLE.

In Ford Co., Kans., in town of Spearville, at the northeast end of base line measured in 1889.

Permanent mark: A cubic yard of concrete underground, with b pier capped with a heavy slab of sandstone above ground. East of base line prolonged 50 feet and a large sandstone with copper buried about 18 inches below surface.

[Latitude, 37° 51′ 06″·34. Longitude, 99° 45′ 10″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wright	57	09	14·70	237	05	13·17	4·059556
First View	154	26	15·92	334	23	17·67	4·214979
Purdyville	119	30	52·45	299	23	27·49	4·308051

ORWELL.

In Hodgeman Co., Kans., in SW. ¼ of sec. 25, T. 23, R. 23 W., 830 f north and 4,720 feet west of the southeast corner of the section.

Permanent mark: The section corner.

[Latitude, 38° 01′ 25″·08. Longitude, 99° 48′ 16″·96.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
First View	30	27	30 ·5	210	26	27 ·0	3 ·695971
Cheese factory	267	40	36 ·1	87	46	30 ·0	4 ·146807
Last Chance	256	35	58 ·9	76	43	25 ·1	4 ·258737
Frank	199	56	37 ·2	19	50	42 ·8	4 ·331513

FIRST VIEW.

In Hodgeman Co., Kans., in SE. ¼ of sec. 3, T. 24 R. 23, W., 3 feet north and 287 feet east of the south quarter corner of the section, in road.

Permanent mark: The section corner.

[Latitude, 37° 59′ 06″·27. Longitude, 99° 50′ 00″·11.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wright	6	53	17 ·3	186	52	13 ·6	4 ·325833
Spearville	334	23	21 ·2	154	26	19 ·5	4 ·214979

WRIGHT.

In Ford Co., Kans., at the southwest end of the Spearville base line, on highest ground in sec. 8, T. 26, R. 23 W., and just south of the Atchison, Topeka and Santa Fe Railroad, about 2 miles northeast of Wright.

Permanent mark: A cubical block of sandstone, 16 inches square, sunk 15 inches below the surface. Hole drilled in the top and a copper bolt 1 inch in diameter and 6 inches long inserted. Cross cut in the top of the bolt.

[Latitude, 37° 47′ 44″·38. Longitude, 99° 51′ 43″·91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spearville	237	05	13 ·17	57	09	14 ·70	4 ·059556
Purdyville	153	33	07 ·03	333	29	44 ·12	4 ·258198
Dodge	82	26	03 ·26	262	19	25 ·23	4 ·205125
Meridian	118	12	50 ·87	298	07	50 ·16	4 ·133663
First View	186	52	13 ·6	6	53	17 ·3	4 ·325833

PURDYVILLE.

In Hodgeman Co., Kans., in section 21, near the southeast corner, 54·5 feet north of corner.

Permanent mark: Bottle placed 2 feet below surface, above which i placed a rock, marked thus ◬, to note the center of the station

[Latitude, 37° 56′ 30″·51. Longitude, 99° 57′ 14″·45.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Spearville	299	23	27·49	119	30	52·45	4·308051
Wright............	333	29	44·12	153	33	07·03	4·258198
Dodge	23	08	26·15	203	00	10·33	4·299657
Snyder	58	59	07·72	238	53	08·69	4·221898
Meridian	21	44	24·24	201	42	46·08	4·023153

MERIDIAN.

In Ford Co., Kans., near the center of the north side of sec. 30, T. 25 R. 24, and is on flat ground, a little west of the present location of th public road and on the eastern side of a cornfield.

Permanent mark: Bottle 26 inches below surface, above which is a sandstone rock, marked with a cross and U. S. G. S.

[Latitude, 37° 51′ 12″·71. Longitude, 99° 59′ 54″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Purdyville........	201	42	46·08	21	44	24·24	4·023153
Wright............	298	07	50·16	118	12	50·87	4·133063

DODGE.

In Ford Co., Kans., on the highest part of a hill in section 22, three fourths mile west and one-fourth mile south of Soulé College.

Permanent mark: Bottle 2 feet below surface, above which is a roc marked thus ◬, to note the center of the station.

[Latitude, 37° 43′ 35″·40. Longitude, 100° 02′ 33″·52.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Purdyville	203	00	10·33	23	03	26·15	4·299657
Wright............	262	19	25·23	82	26	03·26	4·205125
Snyder	146	21	47·56	326	19	04·84	4·068561
Grand View......	58	58	41·25	238	51	17·51	4·316707

SNYDER.

In Ford Co., Kans., on west side of sec. 19, T. 25, R. 25, a few hun dred feet northeast of Joseph Ile's house and on the east side of th public road.

3ottle 2½ feet below surface, over which is placed ., to note the center of the station. Instrument

ıde, 37° 51′ 51″·54. Longitude, 100° 06′ 58″·89.]

n.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	238	53	08·69	58	59	07·72	4·221898
....	326	19	04·84	146	21	47·56	4·068561
....	28	51	31·52	208	46	49·89	4·368165
....	86	39	52·28	266	33	48·01	4·162381

GRANDVIEW.

in the SW. ¼ of sec. 23, T. 27, R. 27.

A bottle 2 feet under ground. A small mound is le. Four square holes act as witness marks to

de, 37° 40′ 48″·17. Longitude, 100° 14′ 38″·68.]

n.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	238	51	17·51	58	58	41·25	4·316707
....	208	46	49·89	28	51	31·52	4·368165
....	170	31	39·52	350	30	17·61	4·298094
....	155	16	24·85	335	13	20·97	4·244532
....	133	53	40·90	313	45	27·92	4·436316
....	105	47	51·95	285	39	25·16	4·324018

MARBLE.

, near the southwest corner of sec. 22, T. 25, R. 27.
18 feet.

A bottle 20 inches below surface and a limestone e the bottle.

ıde, 37° 51′ 23″·70. Longitude, 100° 16′ 52″·41.]

on.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	350	30	17·61	170	31	39·52	4·298094
....	266	33	48·01	86	39	52·28	4·162381
....	48	10	44·03	228	09	01·83	3·737785
....	87	40	31·87	267	33	39·97	4·215472

CIMARRON.

, in the NE. ¼ of sec. 1, T. 26, R. 28.

Permanent mark: Bottle 30 inches below the surface, above whic
a rock marked thus ◬, noting center of the station.

[Latitude, 37° 49′ 25″·42. Longitude, 100° 19′ 39″·01.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marble	228	09	01·83	48	10	44·03	3·737785
Grandview	335	13	20·97	155	16	24·85	4·244532

INGALLS.

In Gray Co., Kans., in the NE. ¼ of sec. 26, T. 25, R. 29, about
miles northwest of the railroad station.

Permanent mark: Three triangular holes cut in the ground at
apices of an equilateral triangle 20 feet on each side, and at the ce
of the triangle is a large limestone rock marked with a cross and U.
S., and 27 inches below the surface is a bottle which marks the posi
of the instrument.

[Latitude, 37° 51′ 01″·57. Longitude, 100° 28′ 03″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marble	267	33	39·97	87	40	31·87	4·215472
Grandview	313	45	27·92	133	53	40·90	4·436316
Ina	2	30	50·63	182	30	36·13	4·120838
Pierceville........	106	36	11·30	286	30	00·86	4·187146

INA.

In Gray Co., Kans., about 6 miles south of Ingallsville, and in
northeast quarter of section 3.

Permanent mark: Bottle placed 2 feet below surface, and a la
limestone rock marked thus ◬, noting center of station.

[Latitude, 37° 43′ 53″·57. Longitude, 100° 28′ 27″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ingalls	182	30	36·13	2	30	50·63	4·120838
Grandview	285	39	28·16	105	47	51·95	4·324018
Pierceville........	141	09	11·85	321	03	16·41	4·353848
Desolation	103	07	48·80	282	59	51·04	4·292498

PIERCEVILLE.

In Gray Co., Kans., about one-quarter mile north of the quarter
tion corner between secs. 8, 17, T. 25, R. 30, 2 miles east and one-
mile north of Pierceville.

Permanent mark: Bottle 18 inches below surface, over which i
limestone rock marked thus ◬; 3 small triangular holes placed ab

om the center, occupy the corners of an equilateral triangle as to the surface mark.

[Latitude, 37° 53′ 23″·74. Longitude, 100° 38′ 07″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ina	321	03	16·41	141	09	11·85	4·353848
Ingalls	286	30	00·86	106	36	11·30	4·187146
Desolation	20	28	37·33	200	26	34·32	4·147090
Bullard	85	55	45·43	265	46	44·51	4·334122
Mansfield	130	40	13·54	310	35	42·47	4·151985

DESOLATION.

skell Co., Kans., in the SE. ¼ of sec. 22, T. 26, R. 31. Instru-evated 16 feet.

nent mark: Bottle 18 inches below surface, and above this is rock marked thus △, which is flush with surface.

[Latitude, 37° 46′ 17″·35. Longitude, 100° 41′ 27″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ina	282	59	51·04	103	07	48·80	4·292498
Pierceville	200	26	34·32	20	28	37·33	4·147090
Bullard	124	54	23·64	304	47	26·43	4·306967

MANSFIELD.

ney Co., Kans., 908 feet from the northeast corner of sec. 18, . 31. True bearing from section corner to the station is south vest.

nent mark: Center of well distant from signal 100·3 feet. from station to the well, 135° 29′ 35″.

[Latitude, 37° 58′ 23″·46. Longitude, 100° 45′ 28″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters*
Bullard	44	53	18·86	224	48	48·46	4·182856
Pierceville	310	35	42·47	130	40	13·54	4·151985

BULLARD.

ney Co., Kans., on highest sand hill in sec. 18, T. 25, R. 32, and a st of the main road, south from Garden City, and three-eighths th 20° east of junction of roads southeast and southwest.

nent mark: Bottle 16 inches below surface, over which is a e rock marked thus △ and flush with surface. A mound of sand 2 feet high and 4 feet base was made over this rock. The taken from 3 pits symmetrically placed about 7 feet from the rock

[Latitude, 37° 52′ 33″·13. Longitude, 100° 52′ 48″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pierceville........	265	46	44·51	85	55	45·43	4·334122
Desolation........	304	47	26·43	124	54	23·64	4·306967
Ada	107	38	37·69	287	32	42·22	4·171252
Mansfield.........	224	48	48·46	44	53	18·86	4·182856

COYOTE.

In Finney Co., Kans., on the highest ground in the NE. ¼ of se T. 23, R. 34.

Permanent mark: Bottle 28 inches below the surface, and over a large limestone rock marked with a cross and U. S. G. S. Five north, 5 feet south 60° east, and five feet south 60° west are tria lar holes as witness marks.

[Latitude, 38° 01′ 36″·35. Longitude, 101° 02′ 05″·96.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bullard...........	320	49	42·15	140	55	25·29	4·334226
Mansfield	283	38	26·59	103	48	40·96	4·399038
Lakin	84	15	06·15	264	07	42·41	4·247095
Ada	2	22	23·50	182	22	10·70	4·089010

ADA.

In Finney Co., Kans., on the northeast end of a sand hill, whi very near to the township line and about one-fourth mile east o southwest corner of sec. 31, T. 24, R. 34. This sand hill is the hi anywhere near except one-half mile northeast is a prominent san higher than anything else for several miles around.

Permanent mark: Small stake driven in the ground with a n the top.

[Latitude 37° 54′ 58″·57. Longitude 101° 02′ 26″·76.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bullard...........	287	32	42·22	107	38	37·69	4.171252
Coyote............	182	22	10·70	2	22	23·50	4.089010
Hummock........	78	21	37·29	258	14	33·50	4.235840

LAKIN.

In Kearny Co., Kans., 2,605 feet south 37° 35′ west from the n east corner of sec. 35, T. 22, R. 36.

ermanent mark: Bottle 18 inches below surface. over which is a
ne marked with a cross and U. S. G. S.

[Latitude, 38° 00′ 38″·35. Longitude, 101° 14′ 06″·41.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Coyote	264	07	42·41	84	15	06·15	4·247095
Ada	301	27	53·79	121	35	04·18	4·301805
Hummock	359	01	17·24	179	01	23·24	4·145136
Hartland	51	22	15·51	231	17	03·95	4·199574

HUMMOCK.

n **Kearny Co., Kans.,** a few hundred feet west of the NE. ¼, sec. 14,
5, **R. 36,** on high-sand hill.

ermanent mark: Bottle 18 inches below surface, above which is a
estone rock marked thus △. Rock is covered with a large mound
and.

[Latitude, 37° 53′ 05″·37. Longitude, 101° 13′ 56″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ada	258	14	33·50	78	21	37·29	4·235840
Lakin	179	01	23·24	359	01	17·24	4·145136
Basin	55	32	47·76	235	26	50·09	4·236920
Hartland	107	56	25·79	287	51	08·68	4·122278

HARTLAND.

n **Kearny Co., Kans.,** 35 feet south and 9 feet east of the west quarter
ner of sec. 34, T. 24, R. 37.

ermanent mark: Bottle 18 inches below the surface at station.

[Latitude, 37° 55′ 17″·46. Longitude, 101° 22′ 32″·83.]

To station.	Azimuth.			Back azimute.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lakin	231	17	03·95	51	22	15·51	4.199574
Hummock	287	51	08·68	107	56	25·79	4·122278
Basin	6	35	23·49	186	34	43·37	4·144213

BASIN.

n **Kearny Co., Kans.,** about 6 miles south of Hartland, in the SE. ¼
sec. 8, T. 26, R. 37, on the east end of the highest sand hill in that
inity.

ermanent mark: Bottle 24 inches below surface, above which is
ced a limestone rock marked with a cross. A large mound of sand

covers the rock, and on top of the mound is a large rock not in a
tral position.

[Latitude, 37° 47′ 48″·35. Longitude, 101° 23′ 38″·21.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hummock	235	26	50·99	55	32	47·76	4·236920
Hartland	186	34	43·37	6	35	23·49	4·144213

ECKMAN.

A triangulation station of the U. S. C. & G. Survey in Leavenw
Co., Kans., 537 feet southwest of the northeast corner of sec. 6, T
R. 21, near Daisy P. O. Instrument mounted on tripod 50 feet hig

Permanant mark: Marble post.

[Latitude, 39° 02′ 37″·37. Longitude, 95° 00′ 05″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blue Mound	45	36	56·00	225	30	07·95	4·3399179
Windmill.........	103	57	41·22	283	49	48·33	4·2691600
University	65	46	44·07	245	37	35·84	4·3617100

BLUE MOUND.

In Douglas Co., Kans., 6 miles southeast of Lawrence, near cent
sec. 22, T. 13, R. 20. Instrument elevated 20 feet.

Permanent mark: Rock marked U. S. C. S.

[Latitude, 38° 54′ 20″·72. Longitude, 95° 10′ 53″·95.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Eckman	225	30	07·95	45	36	56·00	4·3399179
University........	137	33	01·48	317	30	41·74	3·89943

UNIVERSITY.

In Douglas Co., Kans., in SE. ¼ of sec. 36, T. 12, R. 19, 43 feet n
and 647 feet west of southeast corner of the section on middle towe
the university.

Permanent mark: Middle tower of the university.

[Latitude, 38° 57′ 30″·48. Longitude, 95° 14′ 36″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Eckman	245	37	35·84	65	46	44·07	4·36171
Blue Mound	317	30	41·74	137	33	01·48	3·89943

WINDMILL.

Jefferson Co., Kans., in NE. ¼ sec. 20, T. 11, R. 20, 764 feet north 1,092 feet west of east quarter corner of the section.
ermanent mark: Rock.

[Latitude, 39° 05′ 02″·12. Longitude, 95° 12′ 35″·59.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blue Mound	352	56	25·49	172	57	29·45	4·29948
Eckman	283	49	48·33	103	57	41·22	4·26916
Lecompton	61	48	37·02	241	41	12·22	4·28508

LECOMPTON.

Douglas Co., Kans., in SW. ¼ sec. 15, T. 12, R. 18, 4 feet h and 950 feet east of southwest corner of the section.
rmanent mark: Section corner.

[Latitude, 39° 00′ 06″·17. Longitude, 95° 24′ 21″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
University	288	45	47·24	108	51	55·51	4·17281
Windmill	241	41	12·22	61	48	37·02	4·28508
Newman	153	14	32·17	333	11	38·71	4·16693

PERRY.

Jefferson Co., Kans., in NW. ¼ of sec. 7, T. 11, R. 19 E., 670 feet and 885 feet west of north quarter corner of the section. Instru- on platform 14 feet high.
rmanent mark: Rock sunk in the ground marked with cross.

[Latitude, 39° 06′ 56″·78. Longitude, 95° 20′ 53″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
University	332	31	17·23	152	35	14·74	4·29397
Windmill	286	25	23·13	106	30	40·09	4·09600
Ozawke	191	53	38·77	11	54	14·18	3·81515
Newman	92	15	51·70	272	10	46·57	4·06547

OZAWKE.

Jefferson Co., Kans., in NE. ¼ sec. 19, T. 10, R. 19, 169 feet south feet west of the northeast corner of the section.

Instrument on chimney of house. Permanent mark, same.

[Latitude, 39° 10′ 24″·10. Longitude, 95° 19′ 57″.30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Newman	65	24	57·16	245	19	16·44	4·15406
Perry	11	54	14·18	191	53	38·77	3·81515
Meriden	97	35	55·37	277	26	37·25	4·33010
Rock Creek	122	11	02·11	302	03	52·12	4·28472

NEWMAN.

In Jefferson Co., Kans., in SW. ¼ sec. 1, T. 11, R. 17, 188 feet and 1,104 feet north of southwest corner of the section.

Permanent mark: The section corner.

[Latitude, 39° 07′ 11″·39. Longitude, 95° 28′ 57″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lecompton	333	11	38·71	153	14	32·17	4·16696
Perry	272	10	46·57	92	15	51·70	4·06547
Meriden	136	41	11·34	316	37	34·35	4·07990
Rock Creek	168	15	30·35	348	14	01·67	4·21833
Ozawke	245	19	16·44	65	24	57·16	4·15406

MERIDEN.

In Shawnee Co., Kans., in NE. ¼ sec. 12, T. 10, R. 16, 496 feet and 1,025 feet north of the center of the section.

Permanent mark: Section stone.

[Latitude, 39° 11′ 54″·86. Longitude, 95° 34′ 40″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Newman	316	37	34·35	136	41	11·34	4·07990
Ozawke	277	26	37·25	97	35	55·37	4·33010
Skimmerhorn	110	29	07·89	290	24	41·57	4·03282
Cope	165	37	53·60	345	36	47·18	4·00606

ROCK CREEK.

In Jefferson Co., Kans., in SE. ¼ sec. 16, T. 9, R. 17, 948 feet and 1,563 feet west of the east quarter corner of the section.

Permanent mark: The section corner.

[Latitude, 39° 15′ 56″·26. Longitude, 95° 31′ 17″·35.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Newman	348	14	01·67	168	15	30·35	4·21833
Ozawke	302	03	52·12	122	11	02·11	4·28472
Cope	107	52	17·55	287	49	02·38	3.89003

COPE.

Jackson Co., Kans., in NW. ¼ of sec. 11, T. 9, R. 16, 33 feet east
1,059 feet south of the northwest corner of the section. Instru-
t elevated 20 feet.
ermanent mark: The section corner.

[Latitude, 39° 17′ 13″·39. Longitude, 95° 36′ 25″·64.

To station.	Azmiuth.			Back azmiuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Meriden	345	36	47·18	165	37	53·60	4·00606
Rock creek	287	49	02·38	107	52	17·55	3·89003
Cedar	205	57	11·31	25	59	12·16	4·02191
Skimmerhorn	51	24	53·24	231	21	33·12	3·98690
Railroad	114	08	36·93	294	04	34.49	4·00201

CEDAR.

Jefferson Co., Kans., in NE. ¼ of sec. 7, T. 8, R. 17. 15 feet west and
feet north of east quarter corner of the section.
ermanent mark: The section corner.

[Latitude, 39° 22′ 20″·01. Longitude, 95° 33′ 13″·35.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cope	25	59	12·16	205	57	11·31	4·02191
Railroad	68	48	39·00	248	42	34·43	4·16944

RAILROAD.

Jackson Co., Kans., in NW. ¼ of sec. 26, T. 8, R. 15, 806 feet
h and 1,497 feet east of the northwest corner of the section. Instru-
t elevated 20 feet.
ermanent mark: The section corner.

[Latitude, 39° 19′ 26″·47. Longitude, 95° 42′ 48″·38.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cope	294	04	34·49	114	08	36·93	4·00201
Skimmerhorn	351	04	38·44	171	05	20·54	4·01213
Cedar	248	42	34·43	68	48	39·00	4·16944
Agency	50	36	29·05	230	31	49·29	4·13703
Pottawatomie	131	11	36·89	311	06	32·52	4·18342

SKIMMERHORN.

Jackson Co., Kans., in SW., ¼ of sec. 25, T. 9, R. 15, 99 feet north
1,445 feet east of the southwest corner of the section. Instru-
t on chimney of Skimmerhorn's house.

Permanent mark: Same.

[Latitude, 39° 13′ 57″·05. Longitude, 95° 41′ 41″·87.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Meriden	290	24	41·57	110	29	07·89	4·03282
Cope	231	21	33·12	51	24	53·24	3·98690
Agency	96	49	59·23	276	44	37·69	4·08909
Railroad	171	05	20·54	351	04	38·44	4·01213

AGENCY.

In Jackson Co., Kans., in NE. ¼ of sec. 27, T. 9, R. 14, 294 feet and 1,163 feet west of the northeast corner of the section. Instru elevated 12 feet.

Permanent mark: The section corner.

[Latitude, 39° 14′ 44″·10. Longitude, 95° 50′ 10″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Skimmerhorn	276	44	37·69	96	49	59·23	4·08909
Railroad	230	31	49·29	50	36	29·05	4·13703
St. Marys	98	14	22·08	278	04	11·44	4·36866
Soldier	138	49	35.52	318	44	53.39	4·20952
Pottawatomie	177	13	19·50	357	12	55·40	4·27343

POTTAWATOMIE.

In Jackson Co., Kans., 482 feet east and 2,263 feet south of the s east corner of sec. 21, T. 7, R. 14.

Permanent mark: Rock marked with cross.

[Latitude, 39° 24′ 52″·00. Longitude, 95° 50′ 48″·21.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Railroad	311	06	32·52	131	11	36·89	4·18342
Agency	357	12	55·40	177	13	19·50	4·27343
Soldier	56	06	27·06	236	02	08·54	4·07010

SOLDIER.

In Jackson Co., Kans., in NW. ¼ of sec. 15, T. 8, R. 13, 77 feet and 2,639 feet south of the northwest corner of the section.

Permanent mark: The section corner.

[Latitude, 39° 21′ 19″·29. Longitude, 95° 57′ 35″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Agency	318	44	53·39	138	49	35·52	4·20952
Pottawatomie	236	02	08·54	56	06	27·06	4·07010
Vienna	138	31	43·28	318	27	09·39	4·19241
St. Marys	54	33	32·69	234	28	03·56	4·18421

ST. MARYS.

., Kans., in NW. ¼ of sec. 17, T. 9, R. 12, 194 feet
ast of the northwest corner of the section.
he section corner.

de, 39° 16′ 31″·60. Longitude, 96° 06′ 15″·10.]

n.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
......	278	04	11·44	98	14	22·08	4·36866
......	234	28	08·56	54	33	32·69	4·18421
......	117	57	17·17	297	48	03·77	4·37407
......	142	55	11·67	322	47	01·73	4·48573
......	185	51	05·70	5	52	01·53	4·31477

VIENNA.

., Kans., 14 miles north of St. Marys and 6 miles
lle, on highest part of ridge running north and
evated 18 feet.
arge wooden plug.

le, 39° 27′ 37″·49. Longitude, 96° 04′ 47″·07.]

n.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
......	318	27	09·39	138	31	43·28	4·19241
......	5	52	01·53	185	51	05·70	4·31477
......	67	42	02·40	247	31	52·03	4·39565
......	100	41	56·67	280	32	49·81	4·32050

LOUISVILLE.

., Kans., in NW. ¼ of sec. 7, T. 8, R. 10, 1,092 feet
est of the north quarter corner of the section.
he section corner.

le, 39° 22′ 30″·40. Longitude, 96° 20′ 48″·35.]

n.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
......	297	48	03·77	117	57	17·17	4·37407
......	247	31	52·03	67	42	02·40	4·39565
......	78	34	21·16	258	27	14·46	4·21585
......	143	54	27·83	323	50	41·88	4·15939

BLAINE.

., Kans., in SE. ¼, sec. 29, T. 6, R. 10, 308 feet north
the southeast corner of the section. Instrument

Permanent mark: The section corner.

[Latitude, 39° 29′ 42″·52. Longitude, 96° 19′ 07″·22.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
St. Marys.........	322	47	01·73	142	55	11·67	4·48573
Vienna...........	280	32	49·81	100	41	56·67	4·32050
Fostoria..........	81	21	27·88	261	16	37·35	4·04316

FOSTORIA.

In Pottawatomie Co., Kans., in NE. ¼ of sec. 6, T. 7, R. 9, 20 south and 273 feet west of the northeast corner of the section.

Permanent mark: The section corner.

[Latitude 39° 28′ 48″·46. Longitude, 96° 26′ 44″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blaine............	261	16	37·35	81	21	27·88	4·04316
Louisville........	323	50	41·88	143	54	27·83	4·15939
Stockdale........	26	57	28·45	206	54	07·14	4·22398
Olesburg.........	62	01	12·24	241	57	22·87	3·99006
Springside........	144	57	31·61	324	55	09·14	3·96900

STOCKDALE.

In Pottawatomie Co., Kans., in NW. ¼ of sec. 21, T. 8, R. 8, 1, feet south and 1,187 feet east of northwest corner of the section.

Permanent mark: The section corner.

[Latitude, 39° 20′ 44″·26. Longitude, 96° 32′ 01″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Louisville........	258	27	14·46	78	34	21·16	4·21585
Fostoria..........	206	54	07·14	26	57	28·45	4·22398
Leonardville......	100	10	44.85	280	10	02·17	4·34929
Olesburg.........	174	12	40·79	354	12	12·95	4·01684

OLESBURG.

In Pottawatomie Co., Kans., in SW. ¼ of sec. 17, T. 7, R. 8, 494 east and 684 feet north of the south quarter corner of the sect Instrument elevated 12 feet.

Permanent mark: The section corner.

[Latitude, 39° 26′ 19″·60. Longitude, 96° 32′ 45″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Stockdale.........	354	12	12·95	174	12	40·79	4·01684
Fostoria..........	241	57	22·87	62	01	12·24	3·99006
Springside........	194	59	56·80	15	01	23·90	4·10185
Leonardville......	73	09	37·16	253	00	21·75	4·33999
Randolph.........	121	37	36·39	301	29	59·01	4·30479

SPRINGSIDE.

Co., Kans., 9 miles north and 2 miles east of Oles-
t mound on east side of the Blue River.
: Stone set 6 inches below the surface; surface
.

titude, 39° 32′ 55″·57. Longitude, 96° 30′ 28″·01.]

ation.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
....	324 55 09·14	144 57 31·61	3·96900
....	15 01 23·90	194 59 56·80	4·10185

LEONARDVILLE.

s., in SW. ¼ of sec. 5, T. 8, R. 6, 609 feet east and
he southwest corner of the section.
The section corner.

titude, 39° 22′ 53″·20. Longitude, 96° 47′ 19″·91.]

ation.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
g.........	253 00 21·75	73 09 37·16	4·33999
e.........	280 10 02·17	100 19 44·85	4·34929
h.........	192 22 51·81	12 24 30·69	4·23879

RANDOLPH.

s., in NW. ¼ of sec. 15, T. 6, R. 6, 2 feet west and
he north quarter corner of the section.
The section corner.

titude, 39° 32′ 02″·03. Longitude, 96° 44′ 44″·33.]

ation.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
....	301 29 59·01	121 37 36·39	4·30479
ville......	12 24 30·69	192 22 51·81	4·23879

FREY.

ation of the U. S. C. & G. S. in Dickinson Co.,
. 12, R. 2 E., 725 feet east and 10 feet south of sup-
section.
: Rock with cross cut in the top.

titude, 39° 01′ 31″·84. Longitude, 97° 10′ 24″·56.]

tation.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
....	227 02 55·22	47 07 58·89	4·198968
....	317 26 31·48	137 32 46·92	4·327989
eek	114 46 07·41	294 37 56·73	4·313964

WILMER.

Triangulation station of the U. S. C. & G. S. in Dickinson Co., K in sec. 1, T. 11, R. 3 E., 1,023 feet north and 689 feet west of the s east corner of the section.

Permanent mark: Rock with cross cut in the top.

[Latitude 39° 07′ 20″·93. Longitude 77° 02′ 22″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Vine Creek	86	02	24·91	265	49	09·80	4·482266
Frey	47	07	58·89	227	02	55·22	4·198968
Butler	128	18	14·75	308	09	55·01	4·383160

VINE CREEK.

Triangulation station of the U. S. C. & G. S. in Ottawa Co., K on highest point of land in vicinity and just east of the road.

Permanent mark: Rock with cross cut in the top.

[Latitude, 39° 06′ 11″·06. Longitude, 97° 23′ 23″·18.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Wilmer	265	49	09·80	86	02	24·91	4·482266
Frey	294	37	56·73	114	46	07·41	4·313964
Monument	144	43	43·12	324	39	29·09	4·222941
Butler	213	19	51·44	33	24	48·06	4·311482

MONUMENT.

In Ottawa Co., Kans., on east side of sec. 35, T. 9, R. 2 W.. on a hill near a monument of loosely piled rock.

Permanent mark: Cross cut in large solid rock.

[Latitude, 39° 13′ 33″·24. Longitude, 97° 30′ 05″·41.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Butler	260	29	24·18	80	38	35·64	4·326176
Vine Creek	324	39	29·09	144	43	43·12	4·222941
Sulphur Springs	177	31	34·34	357	31	10·92	4·311352
Table Mound	243	34	03·83	63	42	35·65	4·335128

BUTLER

In Clay Co., Kans., on east side of sec. 24, T. 9, R. 1 E., on owned by F. A. Butler.

ermanent mark: Rock with cross cut in the top.

[Latitude, 39° 15′ 25″·88. Longitude, 97° 15′ 33″·67.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wilmer	308	09	55 ·01	128	18	14 ·75	4 ·383160
Vine Creek	33	24	48 ·06	213	19	51 ·44	4 ·311482
Monument	80	38	35 ·64	260	29	24 ·18	4 ·326176
Table Mound	166	08	42 ·57	346	08	02 ·59	3 ·800471

TABLE MOUND.

n Clay Co., Kans., on east side of sec. 35, T. 8, R. 1 E., on land ed by James Kerr.

ermanent mark: Large rock placed in the ground with cross cut in top.

[Latitude, 39° 18′ 44″·74. Longitude, 97° 16′ 36″·81.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Butler	346	08	02 ·59	166	08	42 ·57	3 ·800471
Monument	63	42	35 ·65	243	34	03 ·83	4 ·335128
Sulphur Springs	118	16	41 ·14	298	07	44 ·88	4 ·361168
Renshawe	194	05	28 ·03	14	08	31 ·93	4 ·453124

SULPHUR SPRINGS.

Cloud Co., Kans., in the SE. ¼ of the SW. ¼ of sec. 26, T. 7, R. 2 on land owned by Delilah Pearson, on highest mound on the east of the ridge north of the road.

rmanent mark: Cross cut on top of large rock below surface.

[Latitude, 39° 24′ 36″·77. Longitude, 97° 30′ 42″·37.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Table Mound	298	07	44 ·88	118	16	41 ·14	4 ·361168
Monument	357	31	10 ·92	177	31	34 ·34	4 ·311352
Concordia	131	54	17 ·53	311	48	01 ·06	4 ·278919
Wayne	180	56	51 ·05	0	57	05 ·08	4 ·501595
Renshawe	238	19	16 ·55	58	31	18 ·32	4 ·502986

RENSHAWE.

Clay Co., Kans., near the center of sec. 3, T. 6, R. 2 E., on high, ground.

rmanent mark: Cross cut on top of rock placed below the surface.

[Latitude, 39° 33′ 37″·45. Longitude, 97° 11′ 47″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Table Mound	14	08	31 ·93	194	05	28 ·03	4 ·453124
Sulphur Springs	58	31	18 ·32	238	19	16 ·55	4 ·502986
Wayne	119	40	02 ·75	299	28	12 ·85	4 ·484583

WAYNE.

In Republic Co., Kans., in the NE. ¼ of sec. 23, T. 4, R. 2 W. on a flat ridge in a pasture.

Permanent mark: U. S. G. S. cut in a rock.

[Latitude, 39° 41′ 45″·81. Longitude, 97° 30′ 20″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Renshawe	299	28	12·85	119	40	02·75	4·484583
Sulphur Springs	0	57	05·08	180	56	51·05	4·501595
Concordia	37	37	18·92	217	30	47·27	4·380851
Minersville	80	00	05·99	259	52	40·20	4·227801

CONCORDIA.

In Cloud Co., Kans., in the NE. ¼ of the NW. ¼ of sec. 20, T. 6, W., several miles southwest of Concordia.

Permanent mark: Eighteen inches under ground, a small, flat over this, and just below surface, a large chalk rock with U. S. and cross cut in the top.

[Latitude, 39° 31′ 28″·03. Longitude, 97° 40′ 34″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wayne	217	30	47·27	37	37	18·92	4·380851
Sulphur Springs	311	48	01·06	131	54	17·53	4·278919
Scottsville	94	24	35·07	274	13	53·67	4·382625
Jamestown	135	27	10·66	315	20	44·24	4·313986
Minersville	172	55	29·44	352	54	36·00	4·210146

MINERSVILLE.

In Republic Co., Kans., in the NW. ¼ of sec. 31, T. 4, R. 3, south side of the public road.

Permanent mark: A large rock marked with cross and U. S. cut in top.

[Latitude, 39° 40′ 10″·09. Longitude, 97° 41′ 58″·48.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wayne	259	52	40·20	80	00	05·99	4·227801
Concordia	352	54	36·00	172	55	29·44	4·210146
Jamestown	83	30	19·23	263	24	45·73	4·098179

JAMESTOWN.

In Republic Co., Kans., in the SW. ¼ of the SE. ¼ of sec. 35, R. 5, 4 or 5 miles north of Jamestown.

Stone 18 inches below surface; also a surface
ross and U. S. G. S. cut in the top.

ude, 39° 39′ 23″·77. Longitude, 97° 50′ 40″·98.]

tion.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
le........	263	24	45·73	83	30	19·23	4·098179
....	315	20	44·24	135	27	10·66	4·313986
....	36	43	15·66	216	38	59·85	4·204883
ill......	113	12	20·25	293	02	44·42	4·368385

SCOTTSVILLE.

ans., in town of Scottsville, in the SE. ¼ of sec. 11,
nt elevated 20 feet.

Rock with cross and U. S. G. S. cut in the top and
eath it.

ude, 39° 32′ 26″·99. Longitude, 97° 57′ 22″·31.]

on.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	216	38	59·85	36	43	15·66	4·204883
....	274	13	53·67	94	24	35·07	4·382625
....	30	24	50·66	210	19	17·36	4·394697
....	108	43	27·10	288	35	08·48	4·294904
ll......	151	36	35·25	331	31	16·16	4·398771

POINTED HILL.

s., in the NE. ¼ of the NW. ¼ of sec. 3, T. 4, R. 7,
miles east of Jewell City, on the end of Pointed

Rock with cross and U. S. G. S. cut in the top.

tude, 39° 44′ 21″·20. Longitude, 98° 05′ 42″·48.]

ion.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	331	31	16·16	151	36	35·25	4·398771
n	293	02	44·42	113	12	20·25	4·368385
....	23	13	13·99	203	10	13·61	4·233009

CHURCH.

Kans., about 1 mile southwest of two churches, 7
near the center of the NE. ¼ of sec. 21, T. 8, R. 7.
Rock with cross and U. S. G. S. cut in the top.

tude, 39° 20′ 52″·77. Longitude, 98° 06′ 06″·93.]

ion.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	167	28	24·32	347	25	40·22	4·453258
....	210	19	17·36	30	24	50·66	4·394697
....	88	19	13·56	268	11	02·73	4·268287

CEMETERY.

In Jewell Co., Kans., in the SW. ¼ of the SW. ¼ of sec. 24, T. 5, 6 miles south of Jewell City and one-half mile west, on the north of the road across from the cemetery.

Permanent mark: Rock, bottle underneath.

[Latitude, 39° 35′ 51″·53. Longitude, 98° 10′ 25″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Scottsville	288	35	08·48	108	43	27·10	4·294904
Pointed Hill	203	10	13·61	23	13	13·99	4·233009
Church	347	25	40·22	167	28	24·32	4·453258
Blue Hill	23	36	37·39	203	31	09·34	4·489339
Old Well	93	03	20·34	272	48	17·77	4·529188

BLUE HILL.

In Mitchell Co., Kans., on Blue Hill.

Permanent mark: Rock with cross and U. S. G. S. cut in the t

[Latitude, 39° 20′ 34″·43. Longitude, 98° 19′ 01″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cemetery..........	203	31	09·34	23	36	37·39	4·489339
Church	268	11	02·73	88	19	18·56	4·268287
Tipton.............	96	08	17·74	276	00	05·38	4·271773
Old Well..........	144	27	23·82	324	17	51·78	4·567271

TIPTON.

In Osborne Co., Kans., on the east side of sec. 15, T. 8, R. 11, on hill 2 miles west of the town.

Permanent mark: Large limestone rock with cross cut and G. S. on top. Bottom of bottle placed 2 inches below the rock.

[Latitude, 39° 21′ 38″·54. Longitude, 98° 31′ 57″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blue Hill	276	00	05·38	96	08	17·74	4·271773
Old Well	174	00	48·96	353	59	30·59	4·450081
Lawrence	122	38	06·38	302	25	42·34	4·521395

OLD WELL.

In Smith Co., Kans., in the SW. ¼ of the SE. ¼ of sec. 16, T. 11 and is 42 feet north and 138·75 feet west of the northwest corn a stone foundation for a building.

: Cross and U. S. G. S. cut in large rock and a bot-
ath the rock.

Latitude, 39° 36′ 47″·61. Longitude, 98° 34′ 00″·86.]

station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
ill	324	17	51·78	144	27	23·82	4·567271
ery	272	48	17·77	93	03	20·34	4·529188
	353	59	30·59	174	00	48·96	4·450081
nce	67	58	03·61	247	46	56·08	4·431416
	111	17	52·44	291	12	22·56	4·121627

SCHOOL.

ans., near a schoolhouse on the northeast corner of
the corner of the section.

: Stone marked with cross and U. S. G. S.

atitude, 39° 39′ 23″·13. Longitude, 98° 42′ 38″·01.]

station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
ce	40	17	20·06	220	11	41·79	4·292411
ll	291	12	22·56	111	17	52·44	4·121627
om	71	04	28·91	250	53	20·28	4·422513
e	136	11	47·03	316	02	33·80	4·472943

LAWRENCE.

Kans., on a swell of ground near the center of the
, T. 6, R. 14, and about on highest point.

: Cross and U. S. G. S. cut on top of large flat stone;
on it, is underneath the flat stone.

atitude, 39° 31′ 17″·82. Longitude, 98° 51′ 28″·82.]

station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
	302	25	42·34	122	38	06·38	4·521395
ell	247	46	56·08	67	58	03·61	4·431416
om	117	13	09·69	297	07	40·01	4·142876
	220	11	41·79	40	17	20·06	4·292411

HARDILEE.

ans., on the highest point of ground in sec. 20, T. 2,
ter of the SE. ¼.

: White sandstone rock, marked with a cross and

atitude, 39° 50′ 57″·55. Longitude, 98° 57′ 03″·13.]

station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
om	8	17	34·11	188	15	36·90	4·482210
	316	02	33·80	136	11	47·03	4·472943
ound	86	02	23·31	265	54	30·50	4·245229

ENGSTROM.

In Smith Co., Kans., on the north slope of a hill in the NW. sec. 34, T. 5, R. 15.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 39° 34′ 43″·59. Longitude, 99° 00′ 06″·57.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lawrence.........	297	07	40·01	117	13	09·69	4·142876
School............	250	53	20·28	71	04	28·91	4·422513
Twin Mound	98	33	06·14	278	21	10·20	4·432896
Blue Mound	155	24	42·87	335	18	48·60	4·500885
Hardilee..........	188	15	36·90	8	17	24·11	4·482210

BLUE MOUND.

In Phillips Co., Kans., on the highest ground in the NW. ¼ of se T. 2, R. 16, and about half a mile S. 60° W. of mound of the same n

Permanent mark: An inverted bottle placed 14 inches under gr and a surface mark of white limestone 18 inches square, marked a cross and U. S. G. S.

[Latitude, 39° 50′ 17″·51. Longitude, 99° 09′ 21″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Engstrom	335	18	48·60	155	24	42·87	4·500885
Hardilee...........	265	54	30·50	86	02	23·31	4·245229
Plaster Mound ...	76	18	23·88	256	04	57·19	4·489504
Twin Mound	28	40	22·04	208	34	18·55	4·451406

TWIN MOUND.

In Phillips Co., Kans., a little over 1 mile southwest of moun this name. Near the center of the SE. ¼ of sec. 14, T. 5, R. 18.

Permanent mark: A bottle 30 inches below the surface and a sandstone rock flush with surface, upon which is cut a cross.

[Latitude, 39° 36′ 52″·73. Longitude, 99° 18′ 49″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Engstrom.........	278	21	10·20	98	33	06·14	4·432896
Blue...............	208	34	18·55	28	40	22·04	4·451406
Rock Mound......	80	56	27·40	260	50	22·45	4·140899
Plaster Mound ...	136	43	01·80	316	35	40·24	4·380216

ROCK MOUND.

illips Co., Kans., near the southwest part of a prominent mound
8, T. 5, R. 19.
anent mark: A bottle 2 feet underground, and a large sand-
ck a few inches above ground on which a cross is cut.

[Latitude, 39° 35′ 41″·72. Longitude, 99° 28′ 22″·30.]

To station.	Azimuth.			Back azimuth			Log. dist.
	°	′	″	°	′	″	*Meters.*
Twin Mound	260	50	22·45	80	56	27·40	4·140899
Plaster Mound	171	48	15·07	351	46	59·16	4·297703
Densmore	88	18	10·65	268	09	34·95	4·285951

PLASTER MOUND.

illips Co., Kans., within a few feet of the stone north of sec. 30,
. 3, R. 19. On public road. Instrument elevated 14 feet.
anent mark: A bottle 18 inches below the surface and a cross
small limestone rock.

[Latitude, 39° 46′ 18″·67. Longitude, 99° 30′ 21″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Twin Mound	316	35	40·24	136	43	01·80	4·380216
Blue Mound	256	04	57·19	76	18	23·88	4·489504
Stahl	81	03	25·30	260	51	27·71	4·432182
Densmore	39	09	50·51	219	02	29·75	4·416348
Rock Mound	351	46	59·16	171	48	15·07	4·297703

DENSMORE.

orton Co., Kans., about 5 miles southeast of Densmore, between
28 and 33, T. 5, R. 21.
anent mark: A broken bottle 20 inches below surface and large
rock of white limestone with cross cut on top.

[Latitude, 39° 35′ 22″·38. Longitude, 99° 41′ 51″·48.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rock Mound	268	09	34·95	88	18	10·65	4·285951
Plaster Mound	219	02	29·75	39	09	50·51	4·416348
Windmill	76	17	58·46	256	10	07·79	4·259061
Stahl	147	15	43·17	327	11	07·53	4·279125

STAHL.

orton Co., Kans., on highest ground in the NE. ¼ of the SE. ¼
5, T. 4, R. 22., on land owned by Stahl.

Permanent mark: Bottle placed 22 inches below the surface; s
mark, a large white limestone rock on which a cross is cut.

[Latitude, 39° 44′ 00″·81. Longitude, 99° 49′ 03″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Densmore.........	327	11	07.53	147	15	43·17	4·279125
Plaster Mound....	260	51	27·71	81	03	25·30	4·432182
Windmill.........	19	50	54·40	199	47	38·54	4·334216
Wakeman	78	15	12·86	258	07	46·99	4·229905

WINDMILL.

In Graham Co., Kans., 1 mile S. 70° W. of 2 windmills, which ar
prominent landmarks for many miles.

Permanent mark: Rock with cross and U. S. G. S. cut in the t

[Latitude, 39° 33′ 02″·28. Longitude, 99° 54′ 10·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Densmore	256	10	07·79	76	17	58·46	4·259061
Stahl	199	47	38·54	19	50	54·40	4·334216
Lenora	104	55	00·15	284	49	56·89	4·070397
Wakeman	151	04	00·44	330	59	51·23	4·284254

WAKEMAN.

In Norton Co., Kans., located on summit of gently rolling
about 6 miles north of Lenora.

Permanent mark: Large rock with cross and U. S. G. S. cut o
and two bottles buried beneath, 12 and 30 inches below surface.

[Latitude, 39° 42′ 08″·15. Longitude, 100° 00′ 41″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Windmill.........	330	59	51·23	151	04	00·44	4·284254
Stahl	258	07	46·99	78	15	12·86	4·229905
Lenora	8	23	24·00	188	22	29·53	4·145046

LENORA.

In Norton Co., Kans., located on a prominent, pointed peak,
miles south of Lenora.

Permanent mark: Large rock with cross and U. S. G. S. cut i
top, and two bottles buried beneath, 12 and 30 inches below the su

[Latitude, 39° 34′ 40″·17. Longitude, 100° 02′ 06″·47.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Windmill.........	284	49	56·89	104	55	00·15	4·070397
Wakeman	188	22	29·53	8	23	24·00	4·145046

ITIONS OF TOWNSHIP AND SECTION CORNERS, SCHOOLHOUSES, CHURCHES, ETC.

r Ts. 20 and 21, Rs. 19 and 20, Anderson Co., Kans. Latitude,
39″·10. Longitude, 95° 14′ 54″·33.

r T. 19 and 20, R. 19 and 20, Anderson Co., Kans. Latitude,
52″·61. Longitude, 95° 14′ 53″·47.

west corner sec. 28, T. 19, R. 12, Barton Co., Kans. Latitude,
33″·29. Longitude, 98° 39′ 46″·92.

east corner sec. 16, T. 19, R. 14, Barton Co., Kans. Latitude,
17″·21. Longitude, 98° 51′ 56″·28.

west corner sec. 19, T. 20, R. 15, Barton Co., Kans. Latitude,
15″·26. Longitude, 99° 01′ 53″·60.

east corner sec. 36, T. 20, R. 12, Barton and Stafford counties,
Latitude, 38° 15′ 37″·92. Longitude, 98° 35′ 22″·11.

a of court-house, Cottonwood Falls, Chase Co., Kans. Lati-
° 22′ 18″·47. Longitude, 96° 32′ 28″·30.

r T. 20 and 21, R. 5 and 6, Chase Co., Kans. Latitude, 38° 15′
Longitude, 96° 49′ 07″·73.

r T. 20 and 21, R. 6 and 7, Chase Co., Kans. Latitude 38° 15
Longitude, 96° 42′ 29″·86.

r T. 19 and 20, R. 7 and 8, Chase Co., Kans. Latitude, 38° 20′
Longitude, 96° 35′ 52″·40.

r T. 19 and 20, R. 6 and 7, Chase Co., Kans. Latitude,
57″·83. Longitude, 96° 42′ 30″·25.

r T. 18 and 19, R. 7 and 8, Chase Co., Kans. Latitude,
11″·61. Longitude, 96° 35′ 50″·45.

east corner sec. 35, T. 8, R. 1 E., Clay Co., Kans. Latitude,
29″·1. Longitude, 97° 16′ 36″·7.

uarter corner secs. 24 and 19, T. 9, R. 1 and 2 E., Clay Co.,
Latitude, 39° 15′ 27″·02. Longitude, 97° 15′ 32″·88

uarter north corner sec. 20, T. 6, R. 3, Cloud Co., Kans. Lati-
° 31′ 34″·49. Longitude, 97° 40′ 34″·29.

uarter south corner sec. 26, T. 7, R. 2, Cloud Co., Kans. Lati-
° 24′ 35″·86. Longitude, 97° 30′ 43″·88.

r T. 18 and 19, R. 13 and 14, Coffey Co., Kans. Latitude,
05″·58. Longitude, 95° 54′ 45″·04.

r T. 18 and 19, R. 14 and 15, Coffey Co., Kans. Latitude.
05″·34. Longitude, 95° 48′ 06″·91.

r T. 19 and 20, R. 14 and 15, Coffey Co., Kans. Latitude,
51″·74. Longitude, 95° 48′ 07″·69.

r T. 19 and 20, R. 16 and 17, Coffey Co., Kans. Latitude,
53″·15. Longitude, 95° 34′ 53″·15.

lhouse, Lebo, Coffey Co., Kans. Latitude, 38° 25′ 07″·59. Lon-
95° 51′ 29″·45.

Center of sec. 11, T. 12, R. 2, Dickinson Co., Kans. Latitud 01′ 31″·95. Longitude, 97° 10′ 33″·73.

Southeast corner sec. 1, T. 11, R. 3, Dickinson Co., Kans. Lati 39° 07′ 10″·80. Longitude, 97° 02′ 13″·08.

State line, R. 6, Douglas Co., Kans. Latitude, 39° 32′ 24″·73. L tude, 97° 57′ 25″·56.

Southwest corner sec. 22, T. 13, R. 20, Douglas Co., Kans. tude, 38° 54′ 50″·74. Longitude, 95° 11′ 08″·03.

Southeast corner sec. 36, T. 12, R. 19, Douglas Co., Kans. Lati 38° 57′ 30″·06. Longitude, 95° 14′ 28″·13.

Southwest corner sec. 15, T. 12, R. 18, Douglas Co., Kans. tude, 39° 00′ 06″·13. Longitude, 95° 24′ 33″·79.

Garden City, north schoolhouse, Finney Co., Kans. Latitud 58′ 19″·70. Longitude, 100° 52′ 23″·70.

Garden City, south schoolhouse, Finney Co., Kans. Latitud 57′ 39″·18. Longitude, 100° 52′ 14″·77.

Garden City standpipe, Finney Co., Kans. Latitude, 37° 57′ 5 Longitude, 100° 52′ 41″·89.

Pierceville schoolhouse, Finney Co., Kans. Latitude, 37° 53″ 0 Longitude, 100° 40′ 19″·97.

Northeast corner sec. 15, T. 24, R. 34, Finney Co., Kans. Lati 37° 58 25″·84. Longitude, 101° 01′ 43″·08

Northwest corner sec. 15, T. 24, R. 34, Finney Co., Kans. Lati 37° 58′ 25″·27. Longitude, 101° 02′ 49″·03.

Northwest corner sec. 27, T. 23, R. 34, Finney Co., Kans. Lati 38° 01′ 53″·62. Longitude, 101° 02′ 47″·72.

North one-quarter corner sec. 30, T. 25, R. 32, Finney Co., Latitude 37° 51′ 29″·25. Longitude, 100° 52′ 23″·63.

Southeast corner sec. 36, T. 26, R. 31, Finney Co., Kans. Lati 37° 44′ 03″·73. Longitude, 100° 39′ 10″·82.

Northeast corner sec. 18, T. 24, R. 31, Finney Co., Kans. Lati 37° 58′ 25″·98. Longitude, 100° 45′ 17″·15.

Northeast corner sec. 22, T. 26, R. 25, Ford Co., Kans. Lati 37° 46′ 46″·72. Longitude, 100° 01′ 54″·87.

North one-quarter corner sec. 30, T. 25, R. 24, Ford Co., Kans. tude, 37° 51′ 41″·31. Longitude, 99° 52′ 57″·20.

Northeast corner sec. 29, T. 25, R. 22, Ford Co., Kans. Lati 37° 51′ 15″·57. Longitude, 99° 45′ 06″·54.

Southwest corner sec. 8, T. 26, R. 23, Ford Co., Kans. Latitud 47′ 34″·78. Longitude, 99° 52′ 06″·17.

Corner T. 18 and 19, R. 17 and 18, Franklin Co., Kans. Lati 38° 26′ 06″·60. Longitude, 95° 28′ 14″·58.

Cupola of church, Richmond, Franklin Co., Kans. Latitude, 3 14″·64. Longitude, 95° 15′ 10″·71.

Cross on church, Emerald, Franklin Co., Kans. Latitude, 3 13″·58. Longitude, 95° 27′ 09″·65.

oolhouse about 4 miles east of Mansfield, Gray Co., Kans. de, 37° 56′ 11″·52. Longitude, 100° 41′ 58″·42.

arron standpipe, Gray Co., Kans. Latitude, 37° 49′ 00″·32. Lon- , 100° 20′ 48″.05.

arron schoolhouse, Gray Co., Kans. Latitude, 37° 48′ 31″·02. tude, 100° 20′ 40″·80.

ndview schoolhouse, Gray Co., Kans. Latitude, 37° 51′ 21″·97. tude, 100° 20′ 07″·73.

tty Prairie schoolhouse, Gray Co., Kans. Latitude, 37° 50′ . Longitude, 100° 15′ 47″·05.

thwest corner sec. 6, T. 27, R. 30, Gray Co., Kans. Latitude, 37° ′·73. Longitude, 100° 39′ 10″·82.

t quarter corner sec. 26, T. 25, R. 29, Gray Co., Kans. Latitude, ′ 56″·11. Longitude, 100° 27′ 49″·80.

th quarter corner sec. 3, T. 27, R. 29, Gray Co., Kans. Latitude, ′ 11″·57. Longitude, 100° 28′ 40″·47.

thwest corner sec. 19, T. 25, R. 27, Gray Co., Kans. Latitude, ′ 20″·61. Longitude, 100° 20′ 09″·49.

theast corner sec. 27, T. 25, R. 27, Gray Co., Kans. Latitude, ′ 27″·35. Longitude, 100° 15′ 45″·94.

thwest corner sec. 31, T. 25, R. 27, Gray Co., Kans. Latitude, ′ 36″·18. Longitude, 100° 20′ 09″·60.

thwest corner sec. 22, T. 25, R. 27, Gray Co., Kans. Latitude, ′ 20″·10. Longitude, 100° 16′ 52″·56.

th quarter corner sec. 23, T. 27, R. 27, Gray Co., Kans. Latitude, ′ 42″·46. Longitude, 100° 14′ 26″·80.

thwest corner sec. 8, T. 25, R. 30, Gray Co., Kans. Latitude, ′ 01″·44. Longitude, 100° 38′ 42″·51.

theast corner sec. 16, T. 22, R. 1 W., Harvey Co., Kans. Lati- 38° 08′ 39″·46. Longitude, 97° 25′ 33″·46.

thwest corner sec. 33, T. 21, R. 1 E., Harvey Co., Kans. Lati- 38° 10′ 24″·77. Longitude, 97° 20′ 09″·69.

theast corner sec. 8, T. 22, R. 2, Harvey Co., Kans. Latitude, ′ 40″·37. Longitude, 97° 33′ 17″·20.

theast corner sec. 36, T. 22, R. 1 E. Harvey Co., Kans. Latitude, ′ 10″·40. Longitude, 97° 15′ 46″·12.

thwest corner sec. 4, T. 23, R. 3 W., Harvey and Reno counties, Latitude, 38° 04′ 18″·44. Longitude, 97° 39′ 50″·32.

thwest corner sec. 19, T. 25, R. 25, Hodgeman Co., Kans. Lati- 37° 52′ 09″·59. Longitude, 100° 06′ 59″·15.

theast corner sec. 21, T. 24, R. 24, Hodgeman Co., Kans. Lati- 37° 56′ 29″·98. Longitude, 99° 57′ 14″·34.

theast corner sec. 22, T. 21, R. 22, Hodgeman Co., Kans. Lati- 38° 12′ 13″·49. Longitude, 99° 42′ 58″·18.

thwest corner sec. 14, T. 23, R. 21, Hodgeman Co., Kans. Lati- 38° 03′ 27″·33. Longitude, 99° 36′ 17″·90.

Southeast corner sec. 29, T. 23, R. 21, Hodgeman Co., Kans. tude, 38° 01′ 42″·99. Longitude, 99° 38′ 30″·01.

Southeast corner sec. 3, T. 24, R. 23 W., Hodgeman Co., Kans. tude, 37° 59′ 06″·21. Longitude, 99° 49′ 30″·70.

Southeast corner sec. 25, T. 23, R. 23, Hodgeman Co., Kans. tude, 38° 01′ 16″·87. Longitude, 99° 47′ 17″·96.

Southeast corner sec. 21, T. 7, R. 14, Jackson Co., Kans. Latit 39° 25′ 15″·38. Longitude, 95° 50′ 54″·35.

Northwest corner sec. 15, T. 8, R. 13, Jackson Co., Kans. Latit 39° 21′ 45″·40. Longitude, 95° 57′ 36″·61.

Northwest corner sec. 27, T. 9, R. 14, Jackson Co., Kans. Latit 39° 14′ 47″·01. Longitude, 95° 49′ 55″·40.

Southwest corner sec. 25, T. 9, R. 15, Jackson Co., Kans. Latit 39° 13′ 56″·07. Longitude, 95° 42′ 00″·24.

Northwest corner sec. 26, T. 8, R. 15, Jackson Co., Kans. Latit 39° 19′ 34″·45. Longitude, 95° 43′ 07″·45.

Northwest corner sec. 11, T. 9, R. 16, Jackson Co., Kans. Latit 39° 17′ 23″·86. Longitude, 95° 36′ 26″·06.

North quarter corner sec. 7, T. 11, R. 19, Jefferson Co., Kans. tude, 39° 07′ 03″·40. Longitude, 95° 20′ 42″·15.

East quarter corner sec. 20, T. 11, R. 20, Jefferson Co., Kans. tude, 39° 04′ 54″·57. Longitude, 95° 12′ 21″·73.

Northeast corner sec. 19, T. 19, R. 19, Jefferson Co., Kans. Latit 39° 10′ 25″·77. Longitude, 95° 19′ 43″·14.

Southwest corner sec. 1, T. 11, R. 17, Jefferson Co., Kans. Latit 39° 07′ 00″·46. Longitude, 95° 28′ 59″·40.

East quarter corner sec. 16, T. 9, R. 17, Jefferson Co., Kans. tude, 39° 16′ 05″·63. Longitude, 95° 30′ 57″·47.

East quarter corner sec. 7, T. 8, R. 17, Jefferson Co., Kans. tude, 39° 22′ 12″·42. Longitude, 95° 33′ 12″·80.

Southwest corner sec. 24, T. 5, R. 8, Jewell Co., Kans. Latit 39° 35′ 51″·40. Longitude, 98° 10′ 32″·90.

Quarter north corner sec. 3, T. 4, R. 7, Jewell Co., Kans. Latit 39° 44′ 32″·04. Longitude, 98° 05′ 47″·87.

Hartland schoolhouse, Kearny Co., Kans. Latitude, 37° 53′ 21 Longitude, 101° 22′ 03″·49.

Lakin schoolhouse, Kearny Co., Kans. Latitude, 37° 56′ 30 Longitude, 101° 15′ 27″·00.

Deerfield schoolhouse, Kearny Co., Kans. Latitude, 37° 58′ 54 Longitude, 101° 08′ 06″·13.

West quarter corner sec. 34, T. 24, R. 37, Kearny Co., Kans. tude, 37° 55′ 17″·81. Longitude, 101° 22′ 32″·94.

Northwest corner sec. 11, T. 25, R. 36, Kearny Co., Kans. tude, 37° 54′ 00″·98. Longitude, 101° 14′ 53″·67.

Northeast corner sec. 35, T. 22, R. 36, Kearny Co., Kans. Latit 38° 00′ 58″·76. Longitude, 101° 13′ 46″·56.

heast corner sec. 6, T. 12, R. 12, Leavenworth Co., Kans. Lati-
39° 02′ 42″·60. Longitude, 95° 00′ 03″·84.

ner Towns 19 and 20, Ranges 22 and 23, Linn Co., Kans. Latitude,
′ 48″·72. Longitude, 94° 55′ 02″·97.

ner Towns 19 and 20, State line, Linn Co., Kans. Latitude,
′ 47″·52. Longitude, 94° 36′ 45″·42.

ner Towns 19 and 20, Ranges 12 and 13, Lyon Co., Kans. Lati-
38° 20′ 54″·26. Longitude, 96° 01′ 25″·50.

ner Towns 17 and 18, Ranges 12 and 13, Lyon Co., Kans. Latitude,
′ 21″·70. Longitude, 96° 01′ 24″·07.

ola of State normal school, Emporia, Lyon Co., Kans. Latitude,
′ 50″·96. Longitude, 96° 10′ 47″·52.

hwest corner sec. 13, T. 21, R. 2 E., Marion Co., Kans. Latitude,
′ 04″·86. Longitude, 97° 10′ 10″·83.

heast corner sec. 16, T. 23, R. 1 E., Marion Co., Kans. Latitude,
′ 57″·72. Longitude, 97° 20′ 38″·70.

heast corner sec. 36, T. 21, R. 1 E., Marion and Harvey coun-
ans. Latitude, 38° 10′ 27″·58. Longitude, 97° 15′ 44″·98.

ner Towns 20 and 21, Ranges 4 and 5, Marion Co., Kans. Latitude,
′ 45″·45. Longitude, 96° 55′ 45″·11.

ner Towns 17 and 18, Rangs 20 and 21, Miami Co., Kans. Lati-
38° 31′ 19″·21. Longitude, 95° 08′ 15″·30.

ner Towns 17 and 18, Ranges 22 and 23, Miami Co., Kans. Lati-
38° 31′ 16″·29. Longitude, 94° 55′ 03″·33.

ner Towns 18 and 19, Ranges 24 and 25, Miami Co., Kans. Lati-
38° 26′ 02″·63. Longitude, 94° 41′ 43″·13.

hwest corner sec. 15, T. 8, R. 7, Mitchell Co., Kans. Latitude
′ 04″·73. Longitude, 98° 05′ 50″·81.

quarter south corner sec. 11, T. 6, R. 6, Mitchell Co., Kans.
de, 39° 32′ 24″·73. Longitude, 97° 57′ 25″·56.

ner Towns 17 and 18, Ranges 8 and 9, Morris Co., Kans. Lati-
38° 31′ 23″·60. Longitude, 96° 27′ 51″·51.

hwest corner sec. 33, T. 5, R. 24, Norton Co., Kans. Latitude,
′ 05″·50. Longitude, 100° 02′ 23″·00.

heast corner sec. 5, T. 4, R. 22, Norton Co., Kans. Latitude,
′ 38″·57. Longitude, 99° 48′ 55″·11.

ner Towns 17 and 18, Ranges 15 and 16, Osage Co., Kans. Lati-
38° 31′ 23″·42. Longitude, 95° 41′ 29″·02.

-quarter east corner sec. 15, T. 8, R. 11, Osborne Co., Kans. Lati-
39° 21′ 39″·38. Longitude, 98° 31′ 38″·08.

-quarter west corner sec. 23, T. 6, R. 14, Osborne Co., Kans. Lati-
39° 31′ 09″·68. Longitude, 98° 51′ 32″·13.

hwest corner sec. 36, T. 9, R. 2 W., Ottawa Co., Kans. Lati-
39° 13′ 18″·8. Longitude, 97° 30′ 12″·6.

hwest corner sec. 13, T. 11, R. 1, Ottawa Co., Kans. Latitude,
′ 15″·63. Longitude, 97° 23′ 23″·79.

Northwest corner sec. 6, T. 21, R. 17, Pawnee Co., Kans. La
38° 15′ 38″·22. Longitude, 99° 14′ 01″·82.

Northwest corner sec. 30, T. 22, R. 17, Pawnee Co., Kans. La
38° 06′ 55″·99. Longitude, 99° 14′ 22″·27.

Northwest corner sec. 5, T. 21, R. 19, Pawnee Co., Kans. La
38° 15′ 42″·32. Longitude, 99° 25′ 26″·48.

Northwest corner sec. 17, T. 22, R. 20, Pawnee Co., Kans. La
38° 08′ 43″·37. Longitude, 99° 33′ 02″·88.

Northwest corner sec. 28, T. 5, R. 19, Phillips Co., Kans. La
39° 35′ 52″·18. Longitude, 99° 28′ 41″·34.

One-quarter south corner sec. 14, T. 5, R. 18, Phillips Co.,
Latitude, 39° 36′ 44″·73. Longitude, 99° 19′ 06″·61.

One-quarter north corner sec. 32, T. 2, R. 16, Phillips Co.,
Latitude, 39° 50′ 39″·66. Longitude, 99° 09′ 04″·78.

Northwest corner sec. 21, T. 8, R. 8, Pottawatomie Co. Kans.
tude, 39° 20′ 59″·72. Longitude, 96° 32′ 16″·32.

Southwest corner sec. 5, T. 8, R. 6, Pottawatomie Co., Kans.
tude 39° 22′ 47″·20. Longitude, 96° 47′ 34″·08.

Northeast corner sec. 6, T. 7, R. 9, Pottawatomie Co., Kans.
tude, 39° 28′ 48″·65. Longitude, 96° 26′ 40″·66.

One-quarter south corner sec. 17, T. 7, R. 8, Pottawatomie Co.,
Latitude, 39° 26′ 12″·84. Longitude, 96° 32′ 51″·35.

Southeast corner sec. 29, T. 6, R. 10, Pottawatomie Co., Kans.
tude, 39° 29′ 39″·48. Longitude, 96° 18′ 50″·25.

One-quarter north corner sec. 7, T. 8, R. 10, Pottawatomie Co.,
Latitude, 39° 22′ 41″·20. Longitude, 96° 20′ 32″·57

Northwest corner sec. 17, T. 9, R. 12, Pottawatomie Co.,
Latitude, 39° 16′ 33″·52. Longitude, 96° 06′ 35″·33.

Northeast corner sec. 13, T. 23, R. 5, Reno Co., Kans. Lat
38° 03′ 24″·96. Longitude, 97° 48′ 38″·43.

Southwest corner section 8, T. 22, R. 4, Reno Co., Kans. Lat
38° 08′ 39″·22. Longitude, 97° 47′ 35″·89.

Northwest corner sec. 18, T. 23, R. 7, Reno Co., Kans. Lat
38° 03′ 24″·26. Longitude, 98° 01′ 49″·70.

Northwest corner sec. 8, T. 22, R. 10, Reno Co., Kans. Lat
38° 10′ 22″·12. Longitude 98° 27′ 06″·43.

One-quarter south corner sec. 35, T. 5, R. 4, Republic Co., Kans.
tude, 39° 39′ 17″·65. Longitude, 97° 50′ 50″·43.

One-quarter south corner sec. 30, T. 4, R. 3, Republic Co., Kans.
tude, 39° 40′ 10″·17. Longitude, 97° 41′ 50″·57.

Northeast corner sec. 23, T. 4, R. 2 W., Republic Co., Kans.
tude 39° 41′ 59″·0. Longitude, 97° 29′ 46″·7.

Southeast corner section 16, T. 21, R. 8, Rice Co., Kans. Lati
38° 13′ 00″·15. Longitude, 98° 12′ 53″·68.

Northeast corner section 12, T. 20, R. 8, Rice Co., Kans. Lati
38° 19′ 57″·41. Longitude, 98° 08′ 43″·50.

uthwest corner section 23, T. 20, R. 10, Rice Co., Kans. Latitude,
17′ 23″·38. Longitude, 98° 24′ 20″·49.

ne-quarter north corner sec. 15, T. 6, R. 6, Riley Co., Kans. Lati-
, 39° 32′ 17″·77. Longitude, 96° 44′ 44″ 30.

enter of sec. 12, T. 10, R. 16, Shawnee Co., Kans. Latitude, 39°
4″·71. Longitude, 95° 34′ 46″·93.

utheast corner sec. 16, T. 5, R. 11, Smith Co., Kans. Latitude,
36′ 44″·32. Longitude, 98° 33′ 40″·50.

ne-quarter west corner sec. 30, T. 2, R. 14, Smith Co., Kans. Lat-
e, 39° 51′ 06″·93. Longitude, 98° 57′ 15″·75.

ne-quarter north corner sec. 34, T. 5, R. 15, Smith Co., Kans. Lat-
e, 39° 35′ 01″·40. Longitude, 99° 00′ 03″·34.

rtheast corner sec. 18, T. 21, R. 13, Stafford Co., Kans. Latitude,
13′ 54″·42. Longitude, 98° 47′ 01″·07.

rner Ts. 42 and 43, state line, Bates Co., Mo. Latitude, 38° 28′
66. Longitude, 94° 36′ 44″·57.

rner Ts. 40 and 41, Rs. 30 and 31, Bates Co., Mo. Latitude, 38° 18′
52. Longitude, 94° 17′ 28″·44.

rner Ts. 17 and 18, state line, Cass Co., Mo. Latitude, 38° 31′
36. Longitude, 94° 36′ 42″·39.

TEXAS.

METHODS OF WORK.

Triangulation has been carried on in Texas in two general locali
namely: Middle Texas, or the area between longitude 96° 30′
101°, and Transpecos Texas. The work in the latter region ext
from the western portion of the State as far eastward as longitude 1
and covers the territory between the Rio Grande and the New Me
boundary line. It embraces an area of about 15,000 square miles,
may be described as a belt about 60 miles in width extending fro
Paso about 250 miles down the Rio Grande. The triangulation ea
the Pecos covers an area of about 50,000 square miles, which is app
mately included in a four-sided figure, with Dallas, Roby in Fi
County, Brackettville, and Bastrop at the corners.

Work upon the eastern triangulation was commenced in the vic
of Austin in the summer of 1884. A base line was measured by E
Douglas, assisted by C. H. Fitch, with four meter bars. The loca
of this base is about ten miles southeast from Austin, near Onion Cr
and its adopted length 10,307·201 meters, or about 6·4 miles. De
relating to the Austin base line can be found in the administra
report of Mr. Henry Gannett contained in the Sixth Annual Re
1884–'85. The development from this base included the location
point in Austin, the astronomical position of which had been previo
determined by the U. S. Coast and Geodetic Survey, and from this p
the geodetic positions of the various triangulation points were deri
The azimuth of the Austin base line was determined by Prof. A
Thompson.

The work in Texas remained for two seasons under charge of
Douglas. He was relieved in 1886 by Mr. R. U. Goode, under w
direction all operations in Texas have since been conducted exce
small amount of work around Sierra Blanca in connection with
establishment of the one hundred and fifth meridian, as herein
explained. The triangulation was extended year by year northw
and westward from Austin, and in 1889 a base line of verification
measured near Albany, partially along a railroad tangent through
town, and new astronomic and azimuth determinations were made

The Albany base line is about 9 miles in length and was m
ured twice with a 300-foot steel tape stretched under a tension
pounds. The tape was supported by stakes at intervals of 50

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h were aligned and brought to the grade established by more sub-ial supports, the latter having been previously set in the ground feet apart, and upon which markings of the extremities of the were made. The two direct measurements differed by 0·167 feet, vhen temperature corrections were applied the resulting discrep- was somewhat greater, owing possibly to difficulty experienced at ime of measurement in obtaining the true temperature of the tape. adopted length of the line after applying the corrections for tem-ure, length of tape, difference on posts, inclination, sag, and sea was 45793.652 feet.

e triangulation was extended from the Albany base eastward niles to Dallas, then southward to Temple, where another check obtained by joining with distances from Austin base. The work lso been carried 250 miles southward and 100 miles westward Albany. This work as above was executed principally by Charles rquhart. After the measurement of the Albany base observations zimuth were obtained each year.

e instruments used in this work were an 8-inch theodolite with ers reading to 10 seconds in 1884–'85–'86, and afterwards an instru- with an 11-inch Gambey circle reading by microscopes to single ıds. Various methods of observations were used, principally, how- that of directions, and the whole system of triangulation, both and west of Pecos river, has been divided into convenient figures adjusted by the method of least squares, while station adjustments ie same method were also made whenever necessary.

iangulation was commenced in Transpecos Texas, near Sierra ca, in the spring of 1890. Prof. R. S. Woodward measured a base along the Texas and Pacific Railway and determined the astronom-position of a pier at Sierra Blanca, near the western extremity e base line, and Mr. A. P. Davis developed a small system of tri-lation around Sierra Blanca for the purpose of locating on the 's surface the one hundred and fifth meridian. For a full descrip- of the above operations see Bulletin 70. The work was continued is locality in 1891 by Mr. R. U. Goode, who extended the system ıward and westward, and in 1892 by Mr. Charles F. Urquhart east- and southward.

e signals used in the middle portions of the State were usually from sawed lumber, the instruments resting on the ground or ele- d as the circumstances required. In the latter cases a scaffold for upport of the observer was always erected around an interior tri- on which the instrument rested. In a few instances when it was iecessary to elevate the instrument above the surface of the ground, , when found suitably located, were trimmed and the tops used ignals. In the Transpecos regions the triangulation stations were lly at the summit of sharp and well-defined peaks, and conical piles one from 8 to 12 feet in height were used as signals.

POSITIONS AND DESCRIPTIONS OF STATIONS.

ROSS.

In Dallas Co., Tex., about 8 miles east of Dallas; 50 yards west Mr. Ross's residence and about one-half mile north of the Texas a Pacific Railroad. Instrument elevated 20 feet

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 47′ 19″·39. Longitude, 96° 39′ 49″·01.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Branden	63 01 47·88	242 53 37·16	4·423700
Caruth	128 35 33·33	308 31 59·54	4·117911

CARUTH.

In Dallas Co., Tex., about 6 miles north from the city of Dallas, o Mrs. Caruth's residence.

Permanent mark: South chimney of house.

[Latitude, 32° 51′ 44″·85. Longitude, 96° 46′ 23″·42.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Estelle	96 44 45·88	276 33 48·45	4·500987
Branden	33 27 29·94	213 22 52·23	4·384618
Ross	308 31 59·54	128 35 33·33	4·117911

BRANDEN.

In Dallas Co., Tex., about 12 miles southwest from Dallas and miles west of Duncanville, on land owned by Mrs. Brandenburg, an 200 yards southwest from her house. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 40′ 47″·93. Longitude, 96° 54′ 56″·48.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Estelle	142 49 48·88	322 43 30·99	4·477489
O'Neal	102 46 51·03	282 39 48·04	4·320285
Ross	242 53 37·16	63 01 47·88	4·423700
Caruth	213 22 52·23	33 27 29·94	4·384618

ESTELLE.

In Tarrant Co., Tex., about 5 miles southwest from Grapevine an 1 mile west of the Arlington and Grapevine road, on land owned by th Estelle estate. Instrument elevated 30 feet.

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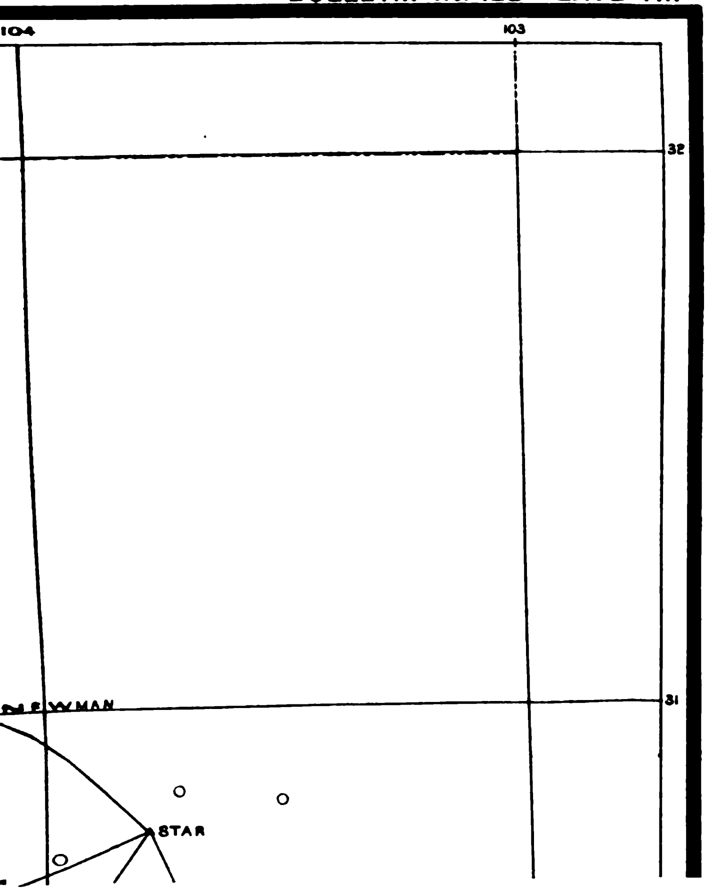

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 53′ 44″·08. Longitude, 97° 06′ 34″·46.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boons	99	51	50·19	279	46	22·20	4·201987
Post Oak	35	03	08·14	214	57	45·41	4·431753
Caruth	276	33	48·45	96	44	45·68	4·500987
Branden	322	43	30·99	142	49	48·88	4·477489
O'Neal	6	32	18·16	186	31	32·13	4·288511

O'NEAL.

n Tarrant Co., Tex., 3 miles southwest from Arlington, on land ned by Mr. J. J. O'Neal, and about 100 yards north of his residence. trument elevated 35 feet.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 43′ 17″·38. Longitude, 97° 07′ 59″·43.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Estelle	186	31	32·13	6	32	18·16	4·288511
Boons	148	32	25·32	328	27	44·15	4·412058
Branden	282	39	48·04	102	46	51·03	4·320285

POST OAK.

n Tarrant Co., Tex., on land owned by Mr. R. E. Maddox, about 6 es south of Fort Worth and 1 mile east from the Fort Worth and nsfield road, on the highest of two timbered knolls. Instrument elevated 35 feet.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 41′ 45″·52. Longitude, 97° 16′ 30″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Caddo Peak	27	50	56·64	207	46	39·85	4·425651
Rattlesnake	108	53	29·14	288	41	33·70	4·560725
Centipede	324	34	05·32	144	36	27·24	4·073005
Estelle	214	57	45·41	35	03	08·14	4·431753
Boons	179	31	42·03	359	31	37·76	4·395540

CENTIPEDE.

n Tarrant Co., Tex., about 5 miles southeast of Kennedale and about miles southwest of the Fort Worth brickyard. On land owned by s. Eliza Turner, and about one-fourth mile east of her residence. trument elevated 35 feet.

[Latitude, 32° 36′ 32″·51. Longitude, 97° 12′ 07″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Post Oak	144	36	27·24	324	34	05·32	4·073005
Caddo Peak	54	14	42·97	234	08	04·97	4·376649

BOONS.

In Tarrant Co., Tex., about 14 miles north of Fort Worth on middle one of three wooded knolls, one-fourth mile east of Mr. Bo residence and 3 miles south of Keller. Instrument elevated 24 fe

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 55′ 12″·22. Longitude, 97° 16′ 38″·17.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rattlesnake	69	04	48·10	248	52	54·76	4·563701
Post Oak	359	31	37·76	179	31	42·03	4·395340
O'Neal	328	27	44·15	148	32	25·32	4·412058
Estelle	279	46	22·20	99	51	50·19	4·201987

RATTLESNAKE.

In Parker Co., Tex., in a pasture owned by Mr. Louch, about 12 east of Weatherford and 2 miles north of the Weatherford and Worth road.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 48′ 05″·84. Longitude, 97° 38′ 32″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Levy	149	10	06·50	329	07	54·20	4·092315
Harrison	90	58	46·37	270	50	35·84	4·372177
Boons	248	52	54·76	69	04	48·10	4·563701
Post Oak	288	41	33·70	108	53	29·14	4·560725
Caddo Peak	327	56	26·38	148	04	02·60	4·619141
Boyles	27	50	44·85	207	47	56·97	4·238563

LEVY.

In Parker Co., Tex., 10 miles north of Weatherford, on the Wea ford and Springtown road, and 2 miles east of Cartersville, on owned by Mr. Levy, who lives in Weatherford.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 53′ 50″·54. Longitude, 97° 42′ 36″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Slipdown	105	57	53·44	285	51	20·46	4·290824
Harrison	59	16	35·60	239	10	36·74	4·301491
Rattlesnake	329	07	54·20	149	10	06·50	4·092315

SLIPDOWN.

In Parker Co., Tex., on land owned by Robert Owen. About 4 southwest of Poolville, on the Weatherford and Gibtown road, 7 miles from Gibtown. Known locally as Slipdown Mountain. Ins ment elevated 24 feet.

Stone marked with a cross and U. S. G. S.

itude, 32° 56′ 44″·38. Longitude, 97° 54′ 39″·80.]

ation.	Azimuth.			Back azimuth.			Log.dist.
	°	′	″	°	′	″	*Meters.*
untain ...	70	34	09·86	250	20	52·58	4·607483
....	86	46	20·80	266	33	38·37	4·562188
....	285	51	20·46	105	57	53·44	4·290824
....	354	08	29·18	174	09	02·57	4·195368

HARRISON.

x., about 7 miles from Weatherford and one-half Weatherford and Palo Pinto road, in small grove

Stone marked with a cross and U. S. G. S.

titude, 32° 48′ 18″·01. Longitude, 97° 53′ 38″·28.]

tion.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	93	03	56·18	272	50	07·07	4·600462
....	174	09	02·57	354	08	29·18	4·195368
....	315	19	33·12	135	24	54·85	4·343432
ke	270	50	35·84	90	58	46·37	4·372177
....	239	10	36·74	59	16	35·60	4·301491

BOYLES.

x., about 7 miles southeast of Weatherford, on land les, and just south of the railroad at his residence.

Stone marked with a cross and U. S. G. S.

itude. 32° 39′ 48″·57. Longitude, 97° 43′ 43″·31.]

ation.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	135	24	54·85	315	19	33·12	4·343432
ake	207	47	56·97	27	50	44·85	4·238563
ak.......	303	25	05·36	123	35	27·87	4·558347

BLUFF.

, Tex., about 10 miles north of the town of Palo est from the Palo Pinto and Jacksboro road; on a ridge and near the bluff.

: Stone marked with a cross and U. S. G. S.

titude, 32° 55′ 35″·49. Longitude, 98° 18′ 02″·09.]

ation..	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
....	8	33	45·40	188	33	09·50	4·062742
....	83	56	15·45	263	49	40·42	4·278668
n	266	33	38·37	86	46	20·80	4·562188

KYLE.

In Palo Pinto Co., Tex., on the highest point of Kyle Mountain, al 4 miles north of the town of Palo Pinto.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 49′ 24″·60. Longitude, 98° 19′ 08″·23.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ioni	42	52	24·36	222	48	05·26	4·279609
Brazos	118	44	20·34	298	38	21·75	4·291895
Slipdown	250	20	52·58	70	34	09·86	4·607483
Harrison	272	50	07·07	93	03	56·18	4·600462
Corbin	349	16	00·77	169	16	41·73	4·024591
Bluff	188	33	09·50	8	33	45·40	4·062742

CORBIN.

In Palo Pinto Co., Tex., about 3 miles south of the town of I Pinto, and one-half mile east from the Palo Pinto and Gordon r Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S. i a tree with the limbs cut off.

[Latitude, 32° 43′ 47″·07. Longitude, 98° 17′ 52″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ioni	76	37	03·48	256	31	53·82	4·185868
Kyle	169	16	41·73	349	16	00·77	4·024591

IONI.

In Palo Pinto Co., Tex., on the highest point of a ridge, 1 mile s of Metcalf's Gap, and 12 miles west from Palo Pinto.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 41′ 51″·43. Longitude, 98° 27′ 25″·52.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cleveland	77	27	18·73	257	19	44·50	4·351462
Brazos	169	41	35·15	349	40	06·58	4·375572
Corbin	256	31	53·82	76	37	03·48	4·185868
Kyle	222	48	05·26	42	52	34·36	4·279609

BRAZOS.

In Palo Pinto Co., Tex., on the highest point of mountain, abo mile north from Randall's store.

rmanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 54′ 29″·77. Longitude, 98° 30′ 09″·01.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cleveland	32	01	15·76	211	55	08·74	4·522671
Breckenridge	68	57	44·14	248	47	02·42	4·518170
Bluff	263	49	40·42	83	56	15·45	4·278668
Kyle	298	38	21·75	118	44	20·34	4·291895
Ioni	349	40	06·58	169	41	35·15	4·375572
Thurman	19	45	51·86	199	42	45·53	4·423297

THURMAN.

Stevens Co., Tex., near Palo Pinto county line. About 5 miles **heast** from Caddo, and one-half mile south from road between **lo and** Gordon. Instrument elevated 20 feet.

rmanent mark: Stone marked with cross and U. S. G. S.

[Latitude, 32° 40′ 59″·96. Longitude, 98° 35′ 53″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Breckenridge	120	56	36·69	300	49	02·98	4·405645
Brazos	199	42	45·53	19	45	51·86	4·423297

CLEVELAND.

Stevens Co., Tex., on school land about 5 miles south from where **Breckenridge** and Palo Pinto road crosses Cedar Creek, and about **ards** east from the road between Cedar Creek and Ranger. On a **led knoll.** Instrument elevated 24 feet.

rmanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 39′ 12″·25. Longitude, 98° 41′ 26″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Breckenridge	141	16	42·28	321	12	09·25	4·322317
Double Mountain	70	32	26·33	250	25	05·18	4·354817
Ioni	257	19	44·50	77	27	18·73	4·351462
Brazos	211	55	08·74	32	01	15·76	4·522671

BRECKENRIDGE.

Stevens Co., Tex., on a high, wooded, ridge, about 7 miles from the **of Breckenridge** and about 200 yards south from the Breckenridge **Graham** road. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 48′ 03″·95. Longitude, 98° 49′ 51″·89.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Flat Top	103	53	13·47	283	44	39·66	4·404595
Double Mountains	18	50	59·18	198	48	09·91	4·403059
Brazos	248	47	02·42	68	57	44·14	4·518170
Thurman	300	49	02·98	120	56	36·69	4·405645
Black Jack	172	26	09·16	352	25	22·02	4·233842
Cleveland	321	12	09·25	141	16	42·28	4·322317

BLACK JACK.

In Stevens or Young county, Tex., near their boundary line. Al 5 miles northeast from Crystal Falls, and a little east from the between Crystal Falls and Belknap. Instrument elevated 24 fee

Permanent mark: Rock marked with a cross and U. S. G. S.

[Latitude, 32° 57′ 15″·29. Longitude, 98° 51′ 18″·72.]

station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Flat Top	64	02	44·01	243	54	56·30	4·396152
Breckenridge	352	25	22·02	172	26	09·16	4·233843

DOUBLE MOUNTAINS.

In Stevens Co., Tex., about 17 miles south of Breckenridge, on eas of two hills, known as Double Mountains. The Breckenridge and C road passes very near the mountains.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 35′ 06″·69. Longitude, 98° 55′ 05″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hitson	72	28	02·10	252	15	15·52	4·591453
Stewart	106	48	24·59	286	32	10·33	4·691354
Breckenridge	198	48	09·91	18	50	59·18	4·403059
Cleveland	250	25	05·18	70	32	26·33	4·354817
New	130	20	23·93	310	20	07·88	4·546872
East Base	106	23	06·91	286	14	01·94	4·438721
Flat Top	151	12	35·41	331	06	52·48	4·534696

FLAT TOP.

On line between Shackelford and Stevens counties, Tex., on the e ern extremity of a hill known as Flat Top mountain. About one- mile north of the Albany and Crystal Falls road, 14 miles from Br enridge, 10 miles from Fort Griffin, and 12 miles from Albany.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 51′ 20″·75. Longitude, 99° 05′ 39″·68.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Stewart	62	31	41·97	242	21	07·64	4·536396
Double Mountains	331	06	52·48	151	12	35·41	4·534696
Black Jack	243	54	56·30	64	02	44·01	4·396152
Breckenridge	283	44	39·66	103	53	13·47	4·404595
New	55	08	23·56	235	04	49·36	4·097992
Irving	154	26	17·89	334	23	45·90	4·225965
Monroe	88	16	49·82	268	06	47·71	4·460537

IRVING.

Throckmorton Co., Tex., about 5 miles northeast of Fort Griffin one mile north from road between Fort Griffin and Belknap, on a -oak ridge. The only post-oak in the country. Instrument elevated eet.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 59′ 33″·38. Longitude, 99° 10′ 19″·31.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Monroe	53	21	22·07	233	13	50·83	4·429910
Flat Top	334	23	45·90	154	26	17·89	4·225965

EAST BASE.

Shackelford Co., Tex., on land owned by Mr. Henry Palm. On a e 7¾ miles southeast from Albany, and just east of Hubbard Creek.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 39′ 17″·06. Longitude, 99° 11′ 56″·21.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
New	178	09	53·23	358	09	43·16	4·179927
Double Mountains	286	14	01·94	106	23	06·91	4·438721
Knoll	131	01	35·12	310	57	52·34	4·153292

KNOLL.

Shackelford Co., Tex., on land owned by Mr. Strum, about 1 mile hwest from Albany and one-fourth mile north from the Albany Haskell road.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 44′ 20″·15. Longitude, 99° 15′ 48″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Base	310	57	52·34	131	01	35·12	4·153292
New	240	30	51·27	60	34	24·38	4·070818

NEW.

In Shackelford Co., Tex., on vacant land, about 7 miles from Alb About 1 mile west from the Albany and Crystal Falls road, and south from a sheep ranch.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 47′ 28″·06. Longitude, 99° 12′ 14″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Flat Top..........	235	04	49·36	55	08	23·56	4·097992
Double Mountains	310	20	07·88	130	29	23·93	4·546872
East Base.........	358	09	43·16	178	09	53·23	4·179927
Knoll.............	60	34	24·38	240	30	51·27	4·070818

MONROE.

In Shackelford Co., Tex., in the Monroe pasture, on a knoll 3½ north of a point on the Albany and Haskell road, and about 7 from Albany.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 50′ 51″·24. Longitude, 99° 24′ 09″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Stewart...........	6	05	56·12	186	05	22·80	4·178596
Flat Top..........	268	06	47·71	88	16	49·82	4·460537
Tarantula.........	131	04	00·21	310	58	27·72	4·323818
Irving............	233	13	50·83	53	21	22·07	4·429910

STEWART.

In Shackelford Co., Tex., in Charles Stewart's pasture, about 9 west from Albany and one-eighth mile north from the point wher Albany and Rising Sun road crosses a high ridge; about 1¼ miles of George Coates' house.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 42′ 44″·26. Longitude, 99° 25′ 11″·16.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hitson............	339	01	52·01	159	05	16·94	4·443369
Double Mountains	286	32	10·33	106	48	24·59	4·691354
Cobb..............	14	12	45·00	194	11	39·85	4·107991
Sand..............	88	57	31·73	268	42	40·49	4·633122
Tarantula.........	153	38	29·43	333	33	30·92	4·507755
Monroe............	186	05	22·80	6	05	56·12	4·178596
Flat Top..........	242	21	07·64	62	31	41·97	4·536396

COBB.

, Tex., in a pasture known as the "Old govern-
it 2 miles south from where the Albany and Abi-
western most of three benches.
Stone marked with a cross and U. S. G. S.

de, 32° 36′ 00″·71. Longitude, 99° 29′ 11″·90.]

on.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
....	106	17	34·44	286	03	49·70	4·617837
....	194	11	39·85	14	12	45·00	4·107991
....	58	19	58·60	238	10	35·19	4·507314
....	29	20	47·83	209	13	30·08	4·639462
....	51	30	46·05	231	17	22·56	4·699218

TARANTULA.

., about one-half mile from the southern edge of
ernmost of two flat-topped hills. It is 300 yards
and Haskell road, at a point 18 miles from Has-
post nearly opposite the hill.
Stone marked with a cross and U. S. G. S.

ide, 32° 58′ 20″·32. Longitude, 99° 34′ 21″·57.]

on.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
....	310	58	27·72	131	04	00·21	4·323818
....	333	33	30·92	153	38	29·43	4·507755
....	51	55	00·79	231	44	30·34	4·584558
....	43	58	23·97	223	48	28·05	4·615150
....	144	18	57·33	324	13	44·49	4·406066
....	94	04	46·70	276	51	02·78	4·597397

HASKELL.

. Not occupied. The cupola on the court-house
at of Haskell County.
Cupola.

ude, 33° 09′ 31″·57. Longitude, 99° 43′ 54″·96.]

on.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
....	324	13	44·49	144	18	57·33	4·406066
....	56	58	55·12	236	50	22·15	4·46368[illegible]

SWINSON.

ex., in the southeast corner of the county, on the
Top Mountain, about 2 miles east of the Anson

Permanent mark: Stone marked with a cross and U S. G. S.

[Latitude, 33° 00′ 56″·10. Longitude, 99° 59′ 34″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tarantula	276	51	02·78	94	04	46·70	4·597397
Sand	342	38	23·37	162	42	08·06	4·558089
Anson	342	14	03·69	162	17	14·43	4·476653
Ash	18	27	17·17	198	23	37·24	4·522820
Haskell	236	50	22·15	56	58	55·12	4·463688
Lom	97	53	38·12	277	39	27·50	4·621348

SAND.

In Jones Co., Tex., on a sand hill about 2 miles east of the Abi and Anson road and 3 miles southeast of Anson. All country near signal covered with thick brush. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 42′ 15″·90. Longitude, 99° 52′ 40″·50.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tarantula	223	48	28·05	43	58	23·97	4·615150
Stewart	268	42	40·49	88	57	31·73	4·633122
Abilene	336	12	05·54	156	16	24·36	4·492986
Buffalo	358	53	43·03	178	53	59·97	4·631206
Cobb	286	03	49·70	106	17	34·44	4·617837
Ash	97	46	04·50	277	38	41·67	4·333057
Swinson	162	42	08·06	342	38	23·37	4·558089

ANSON.

In Jones Co., Tex. Not occupied. The cupola on the court-hou Anson, the county seat of Jones County.

Permanent mark: Cupola.

[Latitude, 32° 45′ 29″·54. Longitude, 99° 53′ 43″·33.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Swinson	162	17	14·43	342	14	03·69	4·476653
Tarantula	231	44	30·34	51	55	00·79	4·584558

ASH.

In Jones Co., Tex., very near the Fisher line, on the highest of sand hills, about 4 miles north from where Mukel and Newman r crosses Clear Fork of the Brazos River, about 2½ miles north of pasture fence.

rmanent mark: Stone marked with a cross and U. S. G. S..

[Latitude, 32° 43′ 49″·63. Longitude, 100° 06′ 19″·79.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Swinson	198	23	37·24	18	27	17·17	4·522820
Sand	277	38	41·67	97	46	04·50	4·333057
Wasp	60	45	09·27	240	34	13·10	4·560635
Fence	22	00	33·83	201	56	09·78	4·533666
Lem	140	22	14·14	320	11	26·93	4·685400

LEM.

Stonewall Co., Tex., on the easternmost of the Double Mountains, e Hetson pasture. The Double mountains are well known points.

rmanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 33° 03′ 59″·68. Longitude, 100° 26′ 11″·37.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Swinson	277	39	07·50	97	53	38·12	4·621348
Ash	320	11	26·93	140	22	14·14	4·685400
Wasp	360	40	08·53	180	39	55·17	4·741118

WASP.

Fisher Co., Tex., about 6 miles a little west of north from Sweet- er, on highest knoll, about one-half mile west from the Sweetwater Roby road.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 34′ 11″·27. Longitude, 100° 26′ 36″·03.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lem	180	39	55·17	360	40	08·53	4·741118
Ash	240	34	13·10	60	45	09·27	4·560635
Sweetwater	342	16	44·21	162	17	55·14	4·053811
Sykes	351	38	24·91	171	39	57·85	4·494016
Bitter	329	17	14·51	149	22	35·58	4·486311
Fence	306	09	14.08	126	15	44·22	4·370810

SWEETWATER.

Nolan Co., Tex. Not occupied. Cupola of the court-house at etwater.

ermanent mark: Cupola.

[Latitude, 32° 28′ 31″·23. Longitude, 100° 24′ 24″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wasp	162	17	55·14	342	16	44·21	4·053811
Fence	281	13	25·27	101	18	44·09	4·199196

FENCE.

In Nolan Co., Tex., in northern edge of the county and 10
little south of east from Sweetwater; about 1 mile south of the w
edge of mountains and on the highest point. A fence running
and south passes within a few yards of the signal. No road ne

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 26′ 40″·88. Longitude, 100° 14′ 30″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wasp	126	15	44·22	306	09	14·08	4·370810
Ash	201	56	09·78	22	00	33·83	4·533666
Sweetwater	101	18	44·09	281	13	25·27	4·199196
Bitter	14	58	10·60	194	57	02·25	4·111270

BITTER.

In Nolan Co., Tex., about 1 mile south from Bitter Creek,
northern edge of a large mesquite ridge, known as "The divide,"
4 miles northeast from a blacksmith shop on the Sweetwater and
ger road, 18 miles from Sweetwater. Instrument elevated 15 fe

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 19′ 55″·64. Longitude, 100° 16′ 37″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wasp	149	22	35·58	329	17	14·51	4·486311
Fence	194	57	02·25	14	58	10·60	4·111270
Rusticus	350	32	47·53	170	33	33·19	4·134508
Sykes	67	58	55·75	247	55	08·54	4·079070

SYKES.

In Nolan Co., Tex., in a pasture owned by Mr. Sykes, abo
yards east from the old Sweetwater and Hayrick road and 1
south of Mr. Sykes's residence; about 13 miles from Sweet
Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 17′ 29″·43. Longitude, 100° 23′ 42″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wasp	171	39	57·85	351	38	24·91	4·494016
Bitter	247	55	08·54	67	58	55·75	4·079070
Rustious	303	45	16·31	123	49	48·77	4·206340

RUSTICUS.

n Nolan Co., Tex., about 50 yards west from the Sweetwater and linger road, at a point between the twenty-first and twenty-second eposts from Sweetwater. Instrument elevated 24 feet.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 12′ 39″·04. Longitude, 100° 15′ 12″·15.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sykes	123	49	48·77	303	45	16·31	4·206340
Bitter	170	33	33·19	350	32	47·53	4·134598

FLINT.

n Taylor Co., Tex., in western part of the county, about 2 miles thwest of Mount Moro P. O. and about 1 mile west from Bluff Creek, vesternmost of two high points on southern edge of ridge. Three lls at the end of the ridge.

[Latitude, 32° 07′ 48″·43. Longitude, 100° 02′ 41″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Plateau	348	42	49·01	168	46	31·55	4·753889
Hayrick	61	47	30·82	241	37	53·52	4·510510

HAYRICK.

n Coke Co., Tex., about 2½ miles a little north of east from the town Hayrick, county seat of Coke County, on the highest point of ridge, ut three-fourths of a mile north from Nipple peak.

ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 59′ 29″·96. Longitude, 100° 20′ 48″·70.]

To station.	Azimuth.			Back azimuth.			Dist. log.
	°	′	″	°	′	″	*Meters.*
Plateau	315	19	25·36	135	32	40·73	4·752501
Cedar	355	52	46·50	175	53	24·39	4·419665
Flint	241	37	53·52	61	47	30·82	4·510510
Austin	101	31	52·52	281	28	17·37	4·036429
Robert Leo	50	19	38·93	230	15	16·95	4·228032
Edith	70	12	40·32	250	02	35·12	4·504418

AUSTIN.

n Coke Co., Tex., on a high point on a prairie ridge, about 10 miles th from Robert Lee and about 1 mile northeast of Mr. Austin's ich.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 00′ 40″·36. Longitude, 100° 27′ 34″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hayrick	281	28	17·37	101	31	52·52	4·036429
Cedar.............	336	06	04·37	156	10	16·72	4·491870
Ashurst..........	41	37	49·89	221	31	15·22	4·470706
Edith.............	56	08	28·93	236	01	58·43	4·368296
Goat.............	92	01	17·03	271	56	34. 51	4·145985
Robert Lee	10	14	32·57	190	13	45·38	4·119880
Lake	61	50	25·53	241	40	40·07	4·518436

GOAT.

In Coke Co., Tex., on the highest point near western end o north of the Colorado River and in the northwest corner of the c about 3 miles north of the Colorado River.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 00′ 56″·09. Longitude, 100° 36′ 27″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Austin	271	56	34·51	92	01	17·03	4·145985
Cedar.............	317	18	24·72	137	27	18·59	4·593599
Ashurst..........	13	58	00·93	193	56	07·97	4·307062
Edith.............	21	43	57·96	201	42	08·80	4·162697
Lake	43	09	10·66	223	04	07·13	4·343381

ROBERT LEE.

In Coke Co., Tex., cupola of the court-house at Robert Lee, seat of Coke Co.

Permanent mark: Cupola.

[Latitude, 31° 53′ 39″·29. Longitude, 100° 29′ 03″·87.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Austin	190	13	45·38	10	14	32·57	4·119880
Hayrick	230	15	16·95	50	19	38·93	4·228032

EDITH.

In Coke Co., Tex., on the northern side of ridge south of the rado River, about 3 or 4 miles west from the discontinued pos Edith.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 53′ 37″·40. Longitude, 100° 39′ 52″·57.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lake	75	05	52·01	255	02	37·24	4·001330
Goat..............	201	42	08·80	21	43	57·26	4·162697
Austin	236	01	58·43	56	08	28·93	4·368296
Hayrick	250	02	35·12	70	12	40·32	4·504418
Cedar.............	295	33	58·37	115	44	39·40	4·549806
Ashurst..........	1	26	54·12	181	26	49·51	3·958473

LAKE.

ear the boundary line between Coke and Tom Green counties, Tex.,
prairie or mesquite ridge; about 8 miles northwest of Ashurst;
it 3 miles west of ranch and farm with two windmills near house;
it 200 yards north of the Colorado City road.
ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 52′ 13″·50. Longitude, 100° 46′ 01″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Goat	223	04	07·13	43	09	10·66	4·343381
Austin	241	40	40·07	61	50	25·53	4·518436
Edith	255	02	37·24	75	05	52·01	4·001330
Ashurst	304	27	08·75	124	30	18·65	4·060096
Napp	335	20	56·70	155	22	31·87	4·056368
Concho	28	47	26·85	208	45	47·18	4·013821

ASHURST.

Coke Co., Tex., on a high prairie or mesquite ridge, in the western
of Mr. Ashurst's pasture, about three-fourths of a mile west from
western windmill; about 15 miles southwest from Robert Lee, and
it 2 miles north from source of Grape Creek.
ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 48′ 42″·42. Longitude, 100° 40′ 01″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Napp	50	50	35·93	330	49	01·33	3·784802
Concho	80	02	14·39	259	57	25·08	4·166284
Lake	124	30	18·69	304	27	08·75	4·060066
Edith	181	26	49·51	1	26	54·12	3·958479
Goat	193	56	07·97	13	58	00·93	4·367062
Austin	221	31	15·22	41	37	49·89	4·470706

NAPP.

Coke Co., Tex., on prairie or mesquite ridge in the northeast corner
Ir. Napp's pasture, about 4 miles southwest from station Ashurst;
it 10 miles north of Water Valley.
ermanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 46′ 37″·47. Longitude, 100° 43′ 00″·86.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lake	155	22	37·24	335	21	02·07	4·0563773
Ashurst	230	48	56·00	50	50	30·60	3·7848272
Gunny	848	12	31·90	168	14	38·97	4·4953233
Water Valley	12	17	43·78	192	16	32·84	4·2228443
Concho	97	39	01·86	277	35	47·26	3·9915558

CONCHO.

In Tom Green Co., Tex., on Prairie Mountain, about 6 or 7 n
northwest from Water Valley and about 4 miles north of the Co
river. The Water Valley and Sterling road passes about 2 miles s
of the station.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 47′ 19″·71. Longitude, 100° 49′ 10″·33.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lake	208	45	47·31	28	47	26·98	4·1383080
Ashurst	259	57	25·08	80	02	14·39	4·1662840
Napp	277	35	47·26	97	39	01·86	3·9915558
Dry	17	07	15·61	197	04	48·59	4·3992513
Water Valley	340	40	32·59	160	42	35·83	4·2712291

WATER VALLEY.

In Sterling Co., Tex. Occupied 1893. On central part of flat por
of hill west of North Concho, and about 2½ miles southwest from W
Valley P. O. The hill is west of a low gap in range of hills south
from Water Valley P. O. The center of station is marked by a 2
scantling, set vertically in ground and wired out.

A stone marked $\frac{\mathrm{U|S}}{\mathrm{G|S}}$ is permanent mark and is 4·26 feet south
42′ west from center of station.

[Latitude, 31° 37′ 47″·51. Longitude, 100° 45′ 15″·85.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Concho	160	42	35·83	340	40	32·59	4·2712291
Napp	192	16	32·84	12	17	43·78	4·2228443
Dry	64	58	05·45	244	53	35·91	4·1752614
Gunny	325	09	14·13	145	12	31·60	4·2411204
Lopez	16	14	25·40	196	11	23·34	4·5178321

DRY.

In Tom Green Co., Tex., in Funk's pasture, at head of Dry Cr
about 10 miles southwest from Water Valley P. O. The station i
a light grove of mesquite. Signal is at top of 16-foot observing p
form. Center is marked by cross on rock sunk in ground
marked $\frac{\mathrm{U|S}}{\mathrm{G|S}}$

[Latitude, 31° 34′ 21″·54. Longitude, 100° 53′ 50″·27.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Water Valley	244	53	35·91	64	58	05.45	4·1752614
Concho	197	04	48·59	17	07	15·61	4·3992513

FUNK.

Irion Co., Tex., in Funk's pasture, about 10 or 12 feet east of line
nce, through which road from San Angelo to Kiowa Creek passes,
about 2 miles north of the Kiowa Creek road. The gate through
h the road goes is about 2 miles west from first house on right of
after crossing Dry Rocky Creek going westward. Signal is at top
-foot observing platform. Center of station is marked by a rock,
in ground, on which is cut $\frac{\text{U}|\text{S}}{\text{G}|\text{S}}$

[Latitude, 31° 31′ 20″·22. Longitude, 100° 48′ 47″·32.]

To station.	Azimuth			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gunny	278	39	01·43	98	44	09·13	4·1963012
Lopez	10	25	13·80	190	24	02·29	4·3018760

GUNNY.

Irion Co., Tex., on knoll near head of and between two branches
ive Oak Creek and about 4 miles north of the San Angelo and Camp
lotte road. The road crosses Live Oak Creek about 14 miles west of
Angelo. Signal is at top of 12-foot observing platform. Center
arked by a rock sunk in the ground with $\frac{\text{U}|\text{S}}{\text{G}|\text{S}}$ cut on it.

[Latitude, 31° 30′ 03″·10. Longitude, 100° 38′ 58″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Napp	168	14	38·97	348	12	31·90	4.4953233
Water Valley	145	12	31·60	325	09	14·13	4·2411204
Dove	356	22	33·57	176	23	15·49	4·5282371
Funk	98	44	09·13	278	39	01·43	4·1963012
Lopez	47	55	55·70	227	49	37·30	4·4123757

LOPEZ.

Irion Co., Tex., on easternmost of the Lopez peaks, about 6 miles
west of Sherwood. Road from Sherwood to Komer's ranch passes
t one-half mile west of station. Signal: Scantling set in pile of
. **Rock** marking station is 6.04 feet south 62° 58′ east from center.

[Latitude, 31° 20′ 40″·27. Longitude, 100° 51′ 04″·44.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gunny	227	49	37·30	47	55	55·70	4·4123757
Water Valley	196	11	23·34	16	14	25·40	4·5178321
Bolt	358	54	21·07	178	54	29·61	4·3584995
Dove	307	24	10·17	127	31	08·76	4·4293467
Funk	190	24	02·29	10	25	13·80	4·3018760

BOLT.

In Irion Co., Tex., on northeastern end of high flat ridge, b
Dove and Spring creeks, about 8 miles (about 20° south of wes
spring at head of Dove Creek and about 3½ miles north of cou
between Irion and Schleicher counties. Signal: Piece of sc
bolted to stump of mesquite tree. Stone marked $\frac{\mathrm{U}\,|\,\mathrm{S}}{\mathrm{G}\,|\,\mathrm{S}}$ is 4 fee
65° 53′ east, from center of station.

[Latitude, 31° 08′ 19″·11. Longitude, 100° 50′ 47″·98.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Dove	252 44 00·72	72 50 49·55	4·3404490
Lopes	178 54 29·61	358 54 21·07	4·3584995

DOVE.

In Tom Green Co., Tex. Occupied 1893. On flat-topped hill
5 miles south from Knickerbocker. The station is near middle
and its center is marked by a rock let in ground and marked
Signal at top of 12-foot observing platform.

[Latitude, 31° 11′ 49″·51. Longitude, 100° 37′ 38″·05.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Lopez	127 31 08·76	307 24 10·17	4·4293467
Gunny	176 23 15·49	356 22 33·57	4·5282371
Bolt	72 50 49·55	252 44 00·72	4·3404490

LIPAN.

In Tom Green Co., Tex., in Keith's pasture on a high mo
about 4½ miles west from Keith's residence, which is 18 mile
San Angelo, on the San Angelo and Fort McKavett road.
peak is about 1 mile east from station.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 14′ 17″·14. Longitude, 100° 19′ 20″·68.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Plateau	220 50 17·65	41 02 38·66	4·757885
Molloy	262 38 21·50	82 52 52·58	4·051065
San Angelo	156 22 57·66	336 19 21·54	4·437322
Cedar	179 34 19·25	359 34 10·75	4·758451

KEITH.

In Tom Green Co., Tex., in Keith's pasture, about 3½ miles southeast from his residence, and on the highest point of ridge. All of the short trees or brush near the signal have been cut down.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 11′ 54″·22. Longitude, 100° 13′ 44″·55.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Molloy	254	07	15·15	74	18	51·70	4·567360
Flower	310	27	46·61	130	32	13·04	4·253929
San Angelo	146	04	30·85	325	58	00·10	4·550798

SAN ANGELO.

The point located is the cupola of the court-house at San Angelo, Tom Green Co., Tex., and was not occupied.

Permanent mark: Cupola.

[Latitude, 31° 27′ 51″·31. Longitude, 100° 26′ 16″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Keith	325	58	00·10	146	04	30·85	4·550798
Lipan	336	19	21·54	156	22	57·66	4·437822

CEDAR.

In Coke Co., Tex., on northeasternmost part of ridge which forms the divide between the Concho and Colorado rivers; about 1 mile a little north of west from a sharp point known as Margaret Peak.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 45′ 18″·85. Longitude, 100° 19′ 26″·94.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Plateau	290	18	03·76	110	30	38·78	4·606208
Lipan	359	34	10·75	179	34	19·25	4·758451
Hayrick	175	53	24·39	355	52	76·50	4·752501
Edith	115	44	39·40	295	33	58·37	4·549806
Goat	137	27	18·59	317	18	24·72	4·593599
Austin	156	10	16·72	336	06	04·37	4·491870

FLOWER.

In Menard Co., Tex., near the northwestern corner of the county, on highest point of a ridge 2½ miles due north of Mr. Skudder's windmill.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 05′ 35″·80. Longitude, 100° 05′ 09″·43.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Molloy	225	13	43·51	45	20	52·23	4·489129
Mustang	290	56	37·72	111	01	21·08	4·192866
Keith	130	32	13·04	310	27	46·61	4·253929

MOLLOY.

In Concho Co., Tex., in the Molloy pasture; about 16 miles sou
Paint Rock; about 6 miles north of Eden; about one-half mil
of the Paint Rock and Eden road; about one-fourth mile south
Molloy water tank; and about 200 yards west from a grove o
oak trees. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 17′ 20″·35. Longitude, 99° 51′ 21″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Plateau	169	44	58·29	349	42	43·58	4·582362
Lipan	82	52	52·88	262	38	21·50	4·651065
Maddox	341	09	21·32	161	12	01·55	4·404850
Live Oak	270	22	20·66	90	28	31·20	4·275801
Keith	74	18	51·70	254	07	15·15	4·567360
Flower	45	20	52·23	220	13	43·51	4·489129
Mustang	15	09	37·94	195	07	13·69	4·451199

LIVE OAK.

In Concho Co., Tex., about 1½ miles west of Walupe Gap a
the highest point of the ridge; about 4 miles north of the Ede
Brady road, at the tenth milepost from Eden.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 17′ 15″·82. Longitude, 99° 39′ 28″·17.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Plateau	145	52	34·27	325	44	07·22	4·659379
Bradley	176	57	10·82	356	56	09·25	4·765113
Bones	359	28	54·07	179	28	59·53	4·490477
Maddox	24	08	19·05	204	04	49·90	4·418098
Molloy	90	28	31·23	270	22	20·66	4·275801

PLATEAU.

In Runnels Co., Tex., about 8½ miles south a little east of Balli
about 2 miles east of the Ballinger and Paint Rock road. Instru
elevated 12 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 37′ 41″·66. Longitude, 99° 55′ 39″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Flint	168	46	24·89	348	42	42·31	4·753890
Molloy	349	42	43·58	169	44	58·29	4·582362
Lipan	41	02	38·66	220	50	17·65	4·757885
Cedar	290	18	03·76	110	30	38·78	4·606208
Hayrick	135	32	40·73	315	19	25·36	4·752501
Bradley	227	43	56·72	47	51	25.68	4·482166
Live Oak	325	24	07·22	145	52	34·27	4·659379

BRADLEY.

In Coleman Co., Tex., very near the Runnels line; about 2 miles north of Talpa, a station on the Gulf, Colorado and Santa Fe Railway; about 3 miles south of Pecan Spring; on southern point of a ridge, and in Mr. Bradley's pasture.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 48′ 43″·66. Longitude, 99° 41′ 25″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Plateau	47	51	25·68	227	48	56·72	4·482166
Table Gap	159	46	29·03	339	43	35·26	4·397060
Live Oak	356	56	09·25	176	57	10·82	4·765113
Ballinger	71	44	28·49	251	36	26·97	4·403896

TABLE GAP.

In Runnels Co., Tex., very near the Taylor County line; about 4 miles west from Content P. O.; on the highest point of ridge, and about 2 miles east from Table Gap.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 01′ 23″.63. Longitude, 99° 46′ 54″·52.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Eagle	164	50	39·48	344	49	08.44	4·234767
Lidel	200	16	24·37	20	19	39·25	4·442051
Bradley	339	43	35·26	159	46	29·03	4·397060
Flint	115	35	14·05	295	26	51·32	4·439516
Rough	304	53	09·79	124	58	32·58	4·290545
Ballinger	26	10	35·80	206	05	26·44	4·543438

ROUGH.

In Coleman Co., Tex.; highest point on a high ridge south of Rough Creek, about 4 miles north of Glen Cove. All timber cleared from the hill except one tree. (Not occupied.)

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 55′ 20″·70. Longitude, 99° 36′ 44″·93.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Table Gap	124	58	32·58	304	53	09·79	4·290545
Lidel	170	16	11·38	350	14	02·14	4·576069

EAGLE.

In Taylor Co., Tex., about a mile east of Guion and about
west of Bald Eagle Peak, on highest point of the ridge.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 10′ 21″·65. Longitude, 99° 49′ 45″·86.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Buffalo	166	59	10·13	346	57	53·77	4·220735
Lidel	236	16	57·82	56	21	44·44	4·228386
Jones	105	44	54·65	285	41	12·08	4·065775
Table Gap	344	49	08·44	164	50	39·48	4·234767
Flint	76	58	43·48	256	51	50·88	4·319290

JONES.

In Taylor Co., Tex., about 10 miles from Buffalo Gap and ab
yards north of the Buffalo Gap and Fort Chadburn road wh
crosses the summit of the ridge near the heads of two Elm creek
running south and the other northeast.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 12′ 01″·65. Longitude, 99° 56′ 43″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Buffalo	208	42	42·96	28	45	09·59	4·174870
Eagle	285	41	12·08	105	44	54·65	4·065775

LIDEL.

In Taylor Co., Tex., near the head of Lidel Creek, about one-hal
north from Buffalo Spring and about one-fourth mile east fro
Mountain Abilene and Coleman road where it crosses the moun
about 13 miles south of Abilene.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 15′ 26″·24. Longitude, 99° 40′ 48″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Buffalo	110	59	02·98	290	52	59·38	4·280402
Cobb	209	13	30·08	29	20	47·83	4·639462
Table Gap	20	19	39·25	200	16	24·37	4·412051
Eagle	56	21	14·44	236	16	57·82	4·228386
Rough	350	14	02·14	170	16	11·38	4·576069

BUFFALO.

In Taylor Co., Tex., about 3 miles northwest from Buffalo Gap, on the highest and northernmost part of the mountains, and about 2½ miles west from where the Abilene and Buffalo Gap road crosses Elm Creek.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 19′ 07″·47. Longitude, 99° 52′ 08″·98.]

To Station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sand	178	53	59·97	358	53	43·03	4·631206
Cobb	231	17	22·56	51	30	46·05	4·699218
Jones	28	45	09·59	208	42	42·96	4·174870
Eagle	346	57	53·77	166	59	10·13	4·220735
Lidel	290	52	59·33	110	59	02·98	4·280402

ABILENE.

In Taylor Co., Tex.; large iron water-tank on west side of Abilene, county seat of Taylor County. Not occupied.

Permanent mark: Tank.

[Latitude, 32° 26′ 51″·39. Longitude, 99° 44′ 39″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sand	156	16	24·36	336	12	05·54	4·492986
Cobb	238	10	35·19	58	19	58·60	4·507314

HITSON.

In Callahan Co., Tex., on westernmost of two hills known as the Hitson Mountains, about 6 miles south from where the Baird and Albany road crosses Hubbard Creek.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 28′ 42″·69. Longitude, 99° 18′ 50″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wesly	273	42	53·74	93	52	14·51	4·436739
Cottonwood	331	19	10·65	151	24	21·02	4·500268
Double Mountains	252	15	15·52	72	28	02·10	4·591453
Stewart	159	05	16·94	339	01	52·01	4·443369

WESLY.

In Eastland Co., Tex., about 6 miles northwest of Cisco, on a wooded peak about 2 miles west from Cedar Mountain. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 27′ 43″·99. Longitude, 99° 01′ 26″·22.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Derrick	333	10	25·57	153	11	46·46	3·941327
Cottonwood	25	06	31·29	205	02	22·75	4·457345
Hitson	93	52	14·51	273	42	53·74	4·436739

CISCO.

In Eastland Co., Tex., 3 miles from the town of Cisco, and abo yards south of the Cisco and Carbon road. Instrument elevated 2

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 22′ 04″·81. Longitude, 98° 56′ 19″·87.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	″	″	*Meters.*
Lost Mountain	356	22	33·22	176	23	19·31	4·555001
Cottonwood	51	55	13·14	231	48	25·05	4·404943

McDANIEL.

In Eastman Co., Tex., about 1¼ miles northwest from Carbo about three-fourths of a mile west from McDaniel's house. It is i thick woods, but has a cleared space around it. Instrument el 32 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 17′ 09″·56. Longitude, 98° 49′ 47″·97.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lost Mountain	16	41	29·05	196	38	46·45	4·445589
Cottonwood	77	47	11·09	257	36	54·30	4·490814
Jameson	268	11	24·21	88	22	16·05	4·504351

COTTONWOOD.

In Callahan Co., Tex., about 3½ miles from the town of Cotton at the head of Sabana Creek on a flat-topped knoll from whi timber has been cut down except one tree on the northwestern the hill.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 18′ 41″·10. Longitude, 99° 09′ 10″·76.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wesly	205	02	22·75	25	06	31·29	4·457345
Derrick	221	30	03·33	41	35	32·26	4·385124
Cisco	231	48	25·05	51	55	13·14	4·404943
McDaniel	257	36	54·30	77	47	11·09	4·490814
Hitson	151	24	21·02	331	19	10·65	4·500268

LOST MOUNTAIN.

In Comanche Co., Tex., in the southwest quarter of section 32, Buffalo, Bayou, Brazos and Colorado Railroad, about 1 mile northwest from Lost Gap.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 02′ 41″·87. Longitude, 98° 54′ 53″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thompson	352	08	37·80	172	09	15·20	4·144092
Santa Anna	48	12	28·03	228	00	02·33	4·697444
Cisco	176	23	19·31	856	22	83·22	4·555001
McDaniel	196	38	46·45	16	41	29·05	4·445589

JAMESON.

In Erath Co., Tex., on mountain known as Jameson Peak, about 3½ miles northeast from Desdemona.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 17′ 40″·67. Longitude, 98° 29′ 27″·79.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mesquite	24	35	52·27	204	29	19·38	4·668979
McDaniel	88	22	16·05	268	11	24·21	4·504351
Guthrie	254	09	48·35	74	13	26·97	4·046149
Price	305	11	47·63	125	15	58·94	4·178679

GUTHRIE.

In Erath Co., Tex., on prairie knoll one-fourth of a mile north of Mr. Guthrie's house and one-fourth of a mile east of the Dublin and Gordon road, at a point about midway between the two towns. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 19′ 19″·02. Longitude, 98° 22′ 38″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Price	352	08	30·62	172	09	03·64	4·073545
Jameson	74	13	26·97	254	09	48·35	4·046149
Murphy	275	32	16·28	95	37	15·16	4·167162

PRICE.

In Erath Co., Tex., on a prairie knoll on land owned by Mr. Price. The knoll is the north one of two, one-eighth of a mile east from the Dublin and Gordon road, at a point about 10 miles from Dublin. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 12′ 58″·07. Longitude, 98° 21′ 36″·91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mesquite	43	20	24·77	223	09	42·33	4·665882
Jameson	125	15	58·94	305	11	47·63	4·178679
Duffau	279	58	34·23	100	10	23·80	4·549481
Guthrie	172	09	03·64	352	08	30·62	4·073545
Murphy	231	35	25·12	51	39	50·55	4·220133

MURPHY.

In Erath Co., Tex., on a prairie knoll known as Murphy Peak, 5 miles north from Stephenville. Instrument elevated 16 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 18′ 32″·64. Longitude, 98° 13′ 19″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Price	51	39	50·55	231	35	25·12	4·220133
Guthrie	95	37	15·16	275	32	16·28	4·167162
Duffau	306	59	49·76	127	07	15·02	4·437557
McClenny	190	51	16·50	10	52	19·07	4·209652

MCCLENNY.

In Erath Co., Tex., in Mr. Robert McClenny's pasture, on the h ground in a small cleared place surrounded by timber; about 6 north of Morgan Mill and 1 mile from McClenny's house. Instr elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 27′ 09″·30. Longitude, 98° 11′ 22″·81.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duffau	329	51	40·11	149	58	03·81	4·573652
Murphy	10	52	19·07	190	51	16·50	4·209652
Comanche	282	43	16·46	102	55	48·97	4·575417

DUFFAU.

In Erath Co., Tex., on ridge of Duffau Mountains, about 1 mile of Skipper Gap. Lines of sight radiating in five different direc cut through timber. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 09′ 36″·80. Longitude, 97° 59′ 24″·87.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Price	100	10	23·80	279	58	34·23	4·549481
Murphy	127	07	15·02	306	59	49·76	4·437557
Comanche	216	39	53·75	36	45	59·93	4·477485
McIver	273	27	44·85	93	32	11·83	4·119548
McClenny	149	58	03·81	329	51	40·11	4·573652

COMANCHE.

In Hood Co., Tex., on Comanche Peak, about 5 miles south of Granbury. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 22′ 28″·19. Longitude, 97° 47′ 59″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duffau	36	45	59·93	216	39	53·75	4·477485
McClenny	102	55	48·97	282	43	16·46	4·575417
Hart	285	27	11·65	105	35	21·26	4·395014
Myers	284	39	48·05	104	45	50·75	4·262942
McIver	10	59	11·04	190	57	32·68	4·403730
Bosque	355	58	45·55	175	59	25·47	4·446622

MYERS.

In Johnson Co., Tex., on land belonging to David Myers. In pasture on ridge east of Barnard Knob and about 2 miles from same. About one-half mile from Myers' house.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 20′ 07″·12. Longitude, 97° 36′ 41″·29.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
McIver	48	12	09·77	228	04	29·89	4·481422
Comanche	104	45	50·75	284	39	48·05	4·262942
Bosque	34	13	36·79	214	08	15·24	4·448663
Gatewood	13	50	09·91	193	47	59·95	4·426920

HART.

In Johnson Co., Tex., about 11 miles from Cleburne, on the highest point on Kennard and Hart's ranch, about three-fourths of a mile west from the Cleburne and Glenrose road.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 19′ 09″·35. Longitude, 97° 32′ 52″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Comanche	105	35	21·26	285	27	11·65	4·395014
Caddo Peak	215	53	57·06	35	58	27·64	4·351907

CADDO PEAK.

In Johnson Co., Tex., on point known as Caddo Peak, 1¾ miles northwest from Joshua, on land owned by Dr. D. B. McWilliam.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 29′ 00″·39. Longitude, 97° 24′ 27″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boyles	123	35	27·87	303	25	05·36	4·558347
Rattlesnake	148	04	02·60	327	56	26·38	4·619141
Centipede	234	08	04·97	54	14	42·97	4·376649
Hart	35	58	27·64	215	53	57·06	4·351907
Post Oak	207	46	39·85	27	50	56·64	4·425651
Widow	277	48	54·06	98	01	15·84	4·561603

WIDOW.

In Ellis Co., Tex., about 4 miles southwest of Midlothian, on owned by Mrs. Taylor, and about one-half mile east of her resid On the highest point in the pasture.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 26′ 17″·43. Longitude, 97° 01′ 24″·99.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Box	50	01	58·11	229	53	39·00	4·503266
Caddo Peak	98	01	15·84	277	48	54·06	4·561603
Turner	13	22	53·37	193	20	27·15	4·491044

BOX.

In Johnson Co., Tex., on Cleburne and Hillsboro road about 9 from Cleburne, on land owned by Mr. Doc Box, about 200 yards s east of Harrell's cotton gin. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 33° 15′ 11″·92. Longitude, 97° 16′ 57″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Widow	229	53	08·52	50	01	27·57	4·503266
Gathings	336	42	50·15	156	44	09·84	3·995976
Turner	299	07	53·13	119	13	44·46	4·296028

TURNER.

In Hill Co., Tex., about 3 miles east of Itasca, on the mountain between Itasca and Hillsboro; on land owned by the Turner heirs cotton field, about 50 yards from where the Hillsboro road turns s Instrument elevated 15 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 09′ 58″·97. Longitude, 97° 05′ 58″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Box	119	13	44·46	299	07	53·13	4·296028
Widow	193	20	27·15	13	22	53·37	4·491044
Hix	62	26	32·62	242	19	04·63	4·396790
Gathings	92	20	42·36	272	16	11·02	4·125922
Frasier	354	16	23·44	174	17	02·67	4·288521

GATHINGS.

In Hill Co., Tex.; about 1½ miles southeastof Covington and about one-half mile east of the Cleburne and Hillsboro road; on land owned by Mr. Philip Gathings.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 10′ 16″·44. Longitude, 97° 14′ 28″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Box	156	44	09·84	336	42	50·15	3·995976
Turner	272	16	11·02	92	20	42·36	4·125922
Frazier	322	21	37·93	142	26	47·85	4·399367

HIX.

In Hill Co., Tex., about 4 miles south from Blanton, on road between Blanton and Fort Graham, one-fourth mile southeast from the road, on land owned by Mr. C. C. Hicks, of Whitney, on a timbered ridge 1 mile south of Mr. Joe Hardin's house. Instrument elevated 35 feet.

Permanent mark: Stone marked with cross and U. S. G. S.

[Latitude, 32° 03′ 43″·68. Longitude, 97° 20′ 01″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Turner	242	19	04·63	62	26	32·62	4·396790
Frazier	287	50	54·26	107	59	00·34	4·402734
Kellum	22	28	41·79	202	24	51·52	4·476845

FRAZIER.

In Hill Co., Tex., about 3½ miles southeast of Hillsboro, on a prairie knoll about 200 yards north of the Hillsboro and Hubbard road, on land owned by Mr. Frazier, and about three-quarters of a mile northeast from his residence.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 59′ 31″·22. Longitude, 97° 04′ 44″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gathings	142	26	47·85	322	21	37·93	4·399367
Turner	174	17	02·67	354	16	23·44	4·288521
Hix	107	59	00·34	287	50	54·26	4·402734
West	4	34	59·77	184	34	26·58	4·315469
Kellum	60	50	19·76	240	38	25·34	4·609780

WEST.

In McLennan Co., Tex., in the town of West, on the Missouri, Kansas and Texas Railroad, on a lot owned by Mr. Zack Davis. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 48′ 22″·07. Longitude, 97° 05′ 47″·56.]

To stations.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kellum	91	17	27·69	271	06	08·24	4·530366
Frazier	184	34	26·58	4	34	59·77	4·315469
Kendrick	21	16	45·73	201	12	17·62	4·570035
Nick	75	45	00·34	255	32	50 75	4·575727

KELLUM.

In Bosque Co., Tex., about 50 yards east from the Fort Graham and Valley Mills road, and about 10 miles from Valley Mills, on a narrow strip of land owned by northern people whose names could not be ascertained. Just north of Kellum's sheep ranch, and about a mile northwest of Mr. Jones' residence. Instrument elevated 15 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 48′ 45″·07. Longitude, 97° 27′ 16″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hix	202	24	51·52	22	22	41·79	4·476345
Frazier	240	38	25·34	60	50	19·76	4·609780
West	271	06	08·24	91	17	27·69	4·530366
Nick	14	15	24·47	194	14	33·46	4·015289

NICK.

In Bosque Co., Tex., in a pasture owned by Mr. Nicholas Eglehart and about one-half mile east of his residence; about 3½ miles north of Valley Mills, and about 1 mile west from the Fort Graham and Valley Mills road. A group of live oak trees about 200 yards southeast of the station.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 43′ 19″·10. Longitude, 97° 28′ 53″·50.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kellum	194	14	33·46	14	15	24·47	4·015289
West	255	32	50·75	75	45	00·34	4·575727
Kendrick	317	34	59·20	137	42	37·79	4·534484
Simpson	3	46	40·55	183	46	23·13	4·123111

SIMPSON.

In McLennan Co., Tex., on the highest point in Mr. Simpson's pasture, about a mile southwest from Patton, on the Gulf, Colorado and Santa Fe Railroad.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 36′ 08″·95. Longitude, 97° 29′ 26″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nick	183	46	23·13	3	46	40·55	4·123111
Kendrick	296	38	31·62	116	46	26·80	4·428396
Ghent	322	16	53·59	152	22	16·39	4·546010

KENDRICK.

In McLennan Co., Tex., on a bluff about 9 miles southwest of Waco, about one-half mile south of the McGregor and Waco road, on land owned by William Payne, about 1 mile south of William Kendrick's residence. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 29′ 37″·62. Longitude, 97° 14′ 18″·50.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nick	187	42	37·79	317	34	59·20	4·584484
West	201	12	17·62	21	16	45·73	4·570035
Ghent	21	52	29·31	201	49	58·33	4·313031
Windmill	75	08	19·87	255	00	07·30	4·411856
Simpson	116	46	26·80	296	38	31·62	4·428396

WINDMILL.

In Coryell Co., Tex., a wind mill in Mr. Arthur Smith's barnyard, about 5 miles west of McGregor and 1 mile north of Oglesby.

Permanent mark: The well.

[Latitude, 31° 26′ 01″·94. Longitude, 97° 30′ 02″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kendrick	255	00	07·30	75	08	19·87	4·411856
Ghent	305	42	05·76	125	47	46·27	4·328232
Lynch	328	18	43·21	148	23	46·33	4·468136

GHENT.

In McLennan Co., Tex., about 2½ miles northeast of Moody on the Moody and Waco road, on land owned by Mr. James Ghent and about one-fourth of a mile south of his residence.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 19′ 18″·01. Longitude, 97° 19′ 08″·22.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Simpson	152	22	16·39	332	16	53·59	4·546010
Kendrick	201	49	58·33	21	52	29·31	4·313031
Windmill	125	47	46·27	305	42	05·76	4·328232

LYNCH.

In Bell Co., Tex., about a mile northeast of Pendleton, on land owned by Dr. J. A. Lynch, on a high point one-fourth of a mile southeast from his residence.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 12′ 29″·66. Longitude, 97° 20′ 19″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cox	115	26	06·33	295	18	36·69	4·404397
Windmill	148	23	46·33	328	18	43·21	4·468136

TEMPLE.

In Bell Co., Tex., center of town tank at Temple Junction.

Permanent mark: The tank.

[Latitude, 31° 05′ 48″·48. Longitude, 97° 20′ 18″·63.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ivy Gap	87	12	45·24	266	56	19·66	4·704689
Haley Ratlif	59	15	24·11	239	03	16·05	4·640355
Cox	135	18	46·73	315	11	20·25	4·510682
Hulsey	97	46	14·13	277	36	46·24	4·468119

HULSEY.

In Bell Co., Tex., on summit of ridge about 4 miles east of Killeen, near the northeast corner of Hulsey's pasture, built close to a post oak tree.

Permanent mark: Stone marked U. S. G. S., 86 and a cross. Distance to station, 6 feet, bearing S. 24° E.

[Latitude, 31° 07′ 56″·19. Longitude, 97° 38′ 37″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Temple	277	36	46·24	97	46	14·13	4·468119
Haley Ratlif	17	37	02·71	197	34	20·51	4·441289
Ivy Gap	73	10	00·84	253	03	02·45	4·350858
Cox	198	11	09·58	18	13	12·47	4·302962
Mistletoe	151	43	14·63	331	38	59·12	4·439109
Rock Spring	99	19	51·71	297	10	14·21	4·676494

IVY GAP.

Near corner of Coryell, Lampasas, and Bell counties, Tex., 3 miles south of Copperas Cave, about 300 yards south of an old road crossing ridge.

Permanent mark: Stone marked U. S. G. S., 86 and cross placed N. 4° W. 7·33 feet from live oak tree.

[Latitude, 31° 04′ 24″·56. Longitude, 97° 52′ 37″·52.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haley Ratlif	326	25	08·21	146	29	23·10	4·376100
Taylor	95	54	38·75	275	51	44·47	3·954102
Temple	266	56	19·66	87	12	45·24	4·704689
Hulsey	258	03	02·45	78	10	00·84	4·350858
Rock Spring	144	24	37·23	324	21	58·87	4·144277

TAYLOR.

In Lampasas Co., Tex., about 2 miles east of Kempner; a flat-topped butte.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 04′ 54″·52. Longitude, 97° 57′ 45″·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bachelors Peak	52	31	31·90	232	27	26·03	4·202526
Waters Mountain	91	53	21·78	271	41	38·29	4·557870
Haley Ratlif	313	07	28·36	133	14	37·11	4·481470
Prairie (1)	359	18	39·69	179	18	45·57	4·402518
Ivy Gap	275	51	44·47	95	54	38·75	3·954102
Rock Spring	184	32	39·25	4	32	55·40	4·018845

ROCK SPRING.

Near line between Coryell and Lampasas counties, Tex., on highest part of mound, about 5 miles northwest from Copperas Cave, on Gulf, Colorado and Santa Fe Railroad, and about 2 miles southeast of Rock Spring, on south end of mound.

Permanent mark: Stone marked with cross and letters U. S. G. S.

[Latitude, 31° 10′ 32″·57. Longitude, 97° 57′ 13″·89.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hulsey	279	10	14·21	99	19	51·71	4·676494
Ivy Gap	324	21	58·87	144	24	37·23	4·144277
Taylor	4	32	55·40	184	32	39·25	4·018845

COX.

In Coryell Co., Tex., on a hill in field belonging to Mr. Cox, about 2½ miles west of The Grove P. O. Station is about 100 yards west of one and 100 yards south of another of two large oak trees in the field.

Permanent mark: Stone marked with cross and letters U. S. G

[Latitude, 31° 18′ 15″·89. Longitude, 97° 34′ 40″·50.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hulsey	18	13	12·47	198	11	09·58	4·302962
Temple	315	11	20·25	135	18	46·73	4·510681
Graves	174	58	29·45	354	57	53·83	4·313900
Ridge	151	16	09·32	331	13	15·48	4·263523
Mistletoe	104	53	39·21	284	47	19·79	4·300152
Lynch	295	18	36·69	115	26	06·33	4·404397

MISTLETOE.

In Coryell Co., Tex., on a small knob near its northwestern The knob is the smaller of two knobs near together, about 7 by road southwest of Gatesville and about one-half mile sout of T. W. Walker's house.

Permanent mark: Stone marked U. S. G. S., '86, and cross is 2 inches under center of station.

[Latitude, 31° 21′ 01″·89. Longitude, 97° 46′ 50″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cox	284	47	19·79	104	53	39·21	4·300152
Hulsey	331	38	59·12	151	43	14·63	4·439109
Bateman	200	18	57·40	20	21	44·29	4·385524
Ridge	223	35	44·58	43	39	10·79	4·180557

RIDGE.

In Coryell Co., Tex., near large oak tree, and about 20 feet e road from Gatesville to Waco, and about 5 miles from Gatesville

Permanent mark: Stone marked with cross and letters U. S. G

[Latitude, 31° 26′ 58″·10. Longitude, 97° 40′ 14″·48.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mistletoe	43	39	10·79	223	35	44·58	4·180557
Cox	331	13	15·43	151	16	09·32	4·263523
Graves	237	38	30·56	57	40	49·22	3·919014
Bateman	170	22	23·26	350	21	43·55	4·078424

GRAVES.

In Coryell Co., Tex., on high ground about 100 yards sout from Mr. Graves's house, about 4 miles southeast of Coryell Cit 2 miles east of Riddle's wells.

Permanent mark: Stone marked with cross and letters U. S. G. S. **Distance** from stone to station, 3·75 feet, bearing S. 45° 54′ E.

[Latitude, 31° 29′ 22″·24. Longitude, 97° 35′ 48″·87].

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ridge............	57	40	49·22	237	38	30·56	3·919071
Cox..............	354	57	53·83	174	58	29·45	4·313900
Bateman..........	129	18	21·25	309	15	22·67	4·066035
Weatherow........	162	34	17·09	342	32	42·73	4·200398

BATEMAN.

In **Coryell** Co., Tex., on prairie ridge, in pasture belonging to Parson **Bateman,** and about one-fourth mile west from his house and about 10 **miles north** from Gatesville.

Permanent mark: Stone marked with cross and letters U. S. G. S.

[Latitude, 31° 33′ 21″·57. Longitude, 97° 41′ 30″·43.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Graves	309	15	22·67	129	18	21·25	4·066035
Ridge..............	350	21	43·55	170	22	23·24	4·078424
Mistletoe	20	21	44·29	200	18	57·40	4·385524
Weatherow..........	208	41	53·16	388	43	17·64	3·947006
Sheep Ranch	152	05	23·06	332	03	03·85	4·174466

WEATHEROW.

In **Coryell** Co., Tex., on high ground about 40 yards southwest of C. C. **Weatherow's** house, about 5 miles east of Turnersville.

Permanent mark: Stone with letters U. S. G. S. and cross cut upon it, **marking** center of station.

[Latitude, 31° 37′ 33″·63. Longitude, 97° 38′ 49″·16.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bateman............	388	43	17·64	208	41	53·16	3·947006
Graves	342	32	42·73	162	34	17·00	4·200398
Sheep Ranch	115	50	45·73	295	47	01·75	4·096662
Lone Tree (2)......	151	19	01·72	331	16	16·95	4·235413

SHEEP RANCH.

In **Bosque** Co., Tex., on prairie ridge about 4 miles west of Hurst **Springs,** 0.27 miles N. 54° E. from corners of Hamilton, Bosque, and **Coryell counties.**

Permanent mark: Stone with the letters U. S. G. S. and a cro upon it showing center of station.

[Latitude, 31° 40′ 30″·16. Longitude, 97° 45′ 56″·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Weatherow	295	47	01·75	115	50	45·73	4·096662
Bateman	332	03	03·85	152	05	23·06	4·174466
Youree	114	50	31·53	294	46	03·05	4·170851
Lone tree (2)	197	10	18·30	17	11	17·82	4·003984

YOUREE.

In Hamilton Co., Tex., on ridge about 5 miles south of C Gap, near Bosque county line, on land belonging to Youree, 40 yards west of his field and opposite the fiftieth fence post northwest corner of field.

Permanent mark: Stone with the letters U. S. G. S. cut on it tance 1·1 feet, bearing north.

[Latitude, 31° 43′ 52″·56. Longitude, 97° 54′ 27″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lone tree (2)	258	10	48·18	78	16	11·56	4·224786
Sheep ranch	294	46	03·05	114	50	31·53	4·170851
Evans	168	22	29·43	348	21	24·95	4·203178
Mound	65	53	42·52	245	47	07·35	4·336705
Prairie (2)	123	31	48·90	303	23	51·25	4·456061
Cowhouse	.....	.....	.....	.....	.....	.....	4·702366

LONE TREE (2).

In Bosque Co., Tex., on ridge north of Neil creek, about 4 west of Norway Mills and one-half mile north of Hagen's house.

Permanent mark: Stone with the letters U. S. G. S. and a cro upon it. Distance to station, 13·1 feet, bearing S. 48° E.

[Latitude, 31° 45′ 43″·23. Longitude, 97° 44′ 02″·92.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sheep ranch	17	11	17·82	197	10	18·30	4·003984
Weatherow	331	16	16·95	151	19	01·72	4·235413
Evans	121	56	18·48	301	49	44·96	4·364021
Youree	78	16	11·56	258	10	43·18	4·224786

ADAMS.

In Bosque Co., Tex., one-fourth mile north of the Meridian and ilton road, at the fifth mile board from Meridian. Instrument ele 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude. 31° 53′ 31″·39. Longitude, 97° 43′ 23″·58.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Doty	112	06	03·23	292	01	39·92	4·149814
Knisely	183	35	41·73	3	35	59·87	4·156671

EVANS.

In Bosque Co., Tex., on ridge at head of middle fork of Meridian Creek, about 1½ miles west of Evans's house and 150 yards west of where the Hico road crosses ridge.

Permanent mark: Stone with letters U. S. G. S. cut on it. Distance to station 2·7 feet, bearing N. 43° E.

[Latitude, 31° 52′ 19″·76. Longitude, 97° 56′ 29″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Youree	348	21	24·95	168	22	29·43	4·203178
Lone tree (2)	301	49	44·96	121	56	18·48	4·364021
Prairie (2)	90	23	46·54	270	16	52·57	4·314008

DOTY.

In Bosque Co., Tex., 4 miles south from Iredell, on a flat, bushy topped knoll, one-eighth mile east of point where the Iredell and Cranfill Gap road gets on top of ridge. Instrument elevated 16 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 56′ 23″·59. Longitude, 97° 51′ 41″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bosque	200	43	26·70	20	46	04·46	4·343054
Knisely	237	08	46·87	57	13	28·82	4·220879
Adams	292	01	39·92	112	06	03·23	4·149814

KNISELY.

In Bosque Co., Tex., in Twin Mountain pasture, 1 mile southeast from Walnut, three-fourths mile southeast from a big barn in a pastrue, and on the highest point in the pasture. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 01′ 16″·18. Longitude, 97′ 42′ 49″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bosque	152	01	35·25	331	59	30·51	4·118170
Gatewood	200	08	17·79	20	09	23·74	3·976004
Adams	3	35	59·87	183	35	41·73	4·156671
Doty	57	13	28·82	237	08	46·87	4·220879

GATEWOOD.

In Bosque Co., Tex., on ridge between Steele and Mustang about 5 miles northeast from Walnut, about 150 yards from Mr wood's house, and near the Glenrose and Morgan road.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 06′ 04″·59. Longitude, 97° 40′ 45″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bosque	106	04	21·72	286	01	10·80	3·991109
Myers	193	47	59·95	13	50	09·91	4·426920
Knisely	20	09	23·74	200	08	17·79	3·976004

BOSQUE.

In Bosque Co., Tex., on ridge between Steele Creek and Hill 5 miles northwest from Walnut, 100 yards west from where road the ridge. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 07′ 32″·51. Longitude, 97° 46′ 44″·20.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Comanche	175	59	25·47	355	58	45·55	4·446622
Myers	214	08	15·24	34	13	36·79	4·448663
Gatewood	286	01	10·80	106	04	21·72	3·991109
Knisely	331	59	30·51	152	01	35·25	4·118170
Doty	20	46	04·46	200	43	26·70	4·343054

McIVER.

In Somerville Co., Tex., on Lavaca Co. school land, about northwest from Walnut and 12 miles north from Iredell, 8 miles west from Glenrose, about 200 yards northwest from Mrs. McIver's house, and one-quarter mile north from Panther Cave Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 32° 09′ 10″·70. Longitude, 97° 51′ 03″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duffau	93	32	11·83	273	27	44·85	4·119548
Comanche	190	57	32·68	10	59	11·04	4·403780
Myers	228	04	29·89	48	12	09·77	4·481422

PRAIRIE (2).

In Hamilton Co., Tex., on prairie ridge, west of Mesquite about 2 miles west of Hamilton and Hico road, at point about north of Hamilton. It is about one mile northwest of Dr. Myers's house and about one-half mile northwest of smaller house.

Permanent mark: Stone marked U. S. G. S., and cross. Distance to station, 2.25 feet, bearing N. 20° W.

[Latitude, 31° 52′ 24″·64. Longitude, 98° 09′ 38″·51.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Evans	270	16	52·57	90	23	46·54	4·314008
Youree	303	23	51·25	123	31	48·90	4·456061
Mound	350	38	22·55	170	39	43·71	4·397543
Mesquite	94	55	18·26	274	38	16·71	4·707480
Cowhouse	62	32	45·85	242	23	55·25	4·475026
Limekiln	....			....			4·707516

MOUND.

In Hamilton Co., Tex., on a mound about 3½ miles south of Hamilton, on Hamilton and Lampasas road, and 100 yards west of road.

Permanent mark: Stone marked U. S. G. S., and cross. Distance to station, 4.75 feet, bearing S. 79° W.

[Latitude, 31° 39′ 04″·46. Longitude, 98° 06′ 59″·33.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	″	″	°	′	″	*Meters.*
Youree	245	47	07·35	65	53	42·52	4·836705
Prairie (2)	170	39	43·71	350	38	22·55	4·397543
Cowhouse	109	37	18·53	289	27	08·57	4·511013

COWHOUSE.

In Comanche Co., Tex., on north end of Cowhouse Mountain, which is about 3 miles south from point where Hamilton and Comanche road crosses south fork of Leon River.

Permanent mark: Stone marked with cross and letters U. S. G. S. Distance to station, 2 feet, bearing S. 40° E.

[Latitude, 31° 44′ 56″·63. Longitude, 98° 26′ 20″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Prairie (2)	242	23	55·25	62	32	45·85	4·475026
Youree	....			....			4·702366
Mound	289	27	08·57	109	37	18·53	4·511013
Mesquite	126	34	59·21	306	26	50·33	4·481871
Limekiln	89	04	49·14	268	57	18·94	4·352634

LIMEKILN.

In Comanche Co., Tex., near an old limekiln on main ridge, about 2½ miles south of Mercers Gap, on the highest part of the ridge.

Permanent mark: Stone marked with a cross and letters U. S.

[Latitude, 31° 44′ 44″·11. Longitude, 98° 40′ 35″·71.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mesquite	174	11	36·76	354	10	59·13	4·267847
Prairie (2).........	....	....	....	....	....	....	4·707516
Cowhouse	268	57	18·94	89	04	49·14	4·352634
Onion Gap.........	....	....	....	....	....	....	4·869130
Santa Anna.........	....	....	....	....	....	....	4·776138
Doubletree	132	19	27·20	312	14	06·44	4·335110
Cabaniss.........	73	44	01·14	253	32	41·39	4·550253

MESQUITE

In Comanche Co., Tex., on north end of high ridge south of w known as Round Mountain. Station is about 3¼ miles northe Logan Gap and about 6 miles west of Comanche.

Permanent mark: Stone marked with cross and letters U. S. Distance to center of station, 5.25 feet, bearing N. 35° E.

[Latitude, 31° 54′ 42″·59. Longitude, 98° 41′ 47″·06.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cowhouse	306	26	50·33	126	34	59·21	4·481871
Prairie (2).........	274	38	16·71	94	55	18. 26	4·707480
Doubletree	74	40	11·67	254	85	27·86	4·165582
Limekiln	354	10	59·13	174	11	36·76	4·267847
Jameson.........	204	29	19·38	24	35	52·27	4·668979
Price	223	09	42·33	43	20	24·77	4·665832

THOMPSON.

In Brown Co., Tex., at the head of Gap Creek, on most westerly of hills that run north from Salt Mountain, and about 5 miles west from Salt Mountain.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 55′ 13″·70. Longitude, 98° 53′ 40″·90.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Doubletree	316	10	12·29	136	11	45·64	3·826419
Santa Anna.........	63	35	32·87	248	22	30·24	4·639546
Lost Mountain ...	172	09	15·20	352	08	37·80	4·144092

DOUBLETREE.

In Brown Co., Tex., on hill about three-quarters of a mile w where Coleman and Comanche road crosses Salt Creek.

Permanent mark: Stone marked with cross and letters U. S. G. S. Distance to station, 8·75 feet, bearing N. 37° E.

[Latitude, 31° 52′ 36″·61. Longitude, 98° 50′ 44″·23.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°		″	*Meters.*
Limekiln	312	14	06·44	132	19	27·20	4·335110
Mesquite	254	35	27·86	74	40	11·67	4·165532
Cabaniss	36	20	10·12	216	14	09·47	4·483744
Santa Anna	71	36	08·62	251	21	33·35	4·663325
Thompson	136	11	45·64	316	10	12·29	3·826419

CABANISS.

In Brown Co., Tex., in pasture belonging to Cabaniss, about 6 miles southwest of Brownwood and about one-half mile west of the Upper Brownwood and Brady road.

Permanent mark: Stone marked with a cross and letters U. S. G. S. cut on it. Distance to station, 6·25 feet; bearing to station S. 48° E.

[Latitude, 31° 39′ 19″·41. Longitude, 99° 02′ 09″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Doubletree	216	14	09·47	36	20	10·12	4·483744
Limekiln	253	32	41·39	78	44	01·14	4·550253
Onion Gap	23	24	12·92	203	18	12·17	4·663016
Santa Anna	111	11	41·75	291	03	09·18	4·439921

SANTA ANNA.

In Coleman Co., Tex., on southern high point of smaller of two peaks overlooking Santa Anna, a station on the Gulf, Colorado and Santa Fe Railroad.

Permanent mark: Stone marked with cross and letters U. S. G. S. cut on it.

[Latitude, 31° 44′ 41″·62. Longitude, 99° 18′ 24″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Doubletree	251	21	33·35	71	36	08·62	4·663325
Limekiln							4·776138
Cabaniss	291	03	09·18	111	11	41·75	4·439921
Antelope							4·796952
Onion Gap	351	47	50·47	171	50	19·07	4·721953
Cow Gap	10	33	35·14	190	30	11·86	4·749595
Lost Mountain	228	00	02·33	48	12	28·03	4·697444
Thompson	243	22	30·24	63	35	32·87	4·639546

ONION GAP.

In McCulloch Co., Tex., on hill in pasture, the southwest corner of which is 10½ miles from Brady, on Brownwood and Brady road. Hill is about 1½ miles from west line of fence and one-fourth mile from line of fence. Station is on highest point of hill and near the c of top of hill.

Permanent mark: Stone marked with cross and letters U. S. G

[Latitude, 31° 16′ 27″·35. Longitude, 99° 13′ 40″·39.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Santa Anna	171	50	19·07	351	47	50·47	4·721953
Antelope	292	09	32·02	112	14	30·64	4·216253
Three-Notch							4·656833
G	343	15	29·05	163	20	00·91	4·686601
Brady	36	33	01·02	216	26	29·03	4·528220
Cow Gap	80	19	12·33	260	13	22·87	4·257128
Cabaniss	203	18	12·17	23	24	12·92	4·663016
Limekiln							4·869130

COW GAP.

On ridge between Colorado River and Brady Creek, and abo miles west of Cow Gap. Road from Brady to Coleman goes thr Cow Gap.

Permanent mark: Stone with letters U. S. G. S. cut on it and marking center of station.

[Latitude, 31° 14′ 48″·17. Longitude, 99° 24′ 53″·81.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Brady	5	18	28·42	185	17	44·81	4·383405
Mason Mountain							4·678370
G							4·731524
Santa Anna	190	30	11·86	10	33	35·14	4·749595
Onion Gap	260	13	22·87	80	19	12·33	4·257128

ANTELOPE.

On west edge of hill, about 17 miles east of Brady; about fourth mile east of northeast corner of large pasture and abou yards from fence.

Permanent mark: Stone marked U. S. G. S., '86, center of stat

[Latitude, 31° 13′ 05″·49. Longitude, 99° 04′ 04″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Three-Notch	336	57	33·99	157	01	39·00	4·507636
G	1	50	34·37	161	50	09·19	4·605837
Mason Mountain							4·632739
Santa Anna							4·796952
Onion Gap	112	14	30·64	292	09	32. 02	4·216253

BALLINGER.

The cupola of the court-house in Ballinger, the county seat of Runnels Co., Tex. Not occupied.

Permanent mark: Cupola.

[Latitude, 31° 44′ 24″·92. Longitude, 99° 56′ 40″·24]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Table Gap	206	05	26·44	26	10	35·80	4·543438
Bradley	251	36	26·97	71	44	28·49	4·403896

BRADY.

In McCulloch Co., Tex., on ridge about 10 miles southwest of Brady; about 4 miles south of Brady and Menardville road, at point about 8 miles from Brady.

Permanent mark: Stone marked with cross and letters U. S. G. S. in center of station.

[Latitude, 31° 01′ 46″·47. Longitude, 99° 26′ 18″·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
G	299	33	56·26	119	44	56·77	4·593743
Mason Mountain							4·462056
Onion Gap	216	26	29·03	36	33	01·02	4·528220
Cow Gap	185	17	44·81	5	18	28·42	4·383405

MASON MOUNTAIN.

In Mason Co., Tex., on southeastern part of highest ridge of Mason Mountain, about 1 mile east of Mason and Camp San Saba road, and 5 miles south of Katemcy.

Permanent mark: Stone marked U. S. G. S. '86 and a cross. Distance to station 21 feet, bearing S. 20° W.

[Latitude, 30° 51′ 08″·67. Longitude, 99° 12′ 55″·59.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
G	268	57	35·23	89	01	42·45	4·107561
Blue Mountain	34	14	49·22	214	07	56·84	4·582486
Brady							4·462056
Antelope							4·632739
Cow Gap							4·678370

G.

In Mason Co., Tex., on a hill 3 miles west of the fourteenth mile post, Mason and Pontotoc road. The mile post is in the Fly Gap.

Permanent mark: A large stone marked with a cross and the U. S. G. S., '86 G. Distance to station 5 feet; bearing to stat 70° W.

[Latitude, 30° 51' 15''·96. Longitude, 99° 04' 53''·53.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	'	''	°	'	''	*Meters.*
Three Notch	232	21	37·76	52	26	06·56	4·2441230
Blue Mountain	47	13	14·22	227	02	15·64	4·6704320
House Mountain	331	43	49·69	151	48	48·79	4·5176159
B	252	05	48·25	72	12	02·82	4·3088710
Brady	119	44	56·77	299	33	56·26	4·5937430
Antelope	181	50	09·19	1	50	34·37	4·6058370
Onion Gap	168	20	00·91	348	15	29·05	4·6866010
Cow Gap							4·7315240
Mason Mountain	89	01	42·45	268	57	35·23	4·1075610

THREE NOTCH.

In Llano Co., Tex., about a mile west of the head of Cold Cr a round-topped hill.

Permanent mark: U. S. G. S. cut on southernmost of 2 con stumps. Distance to station 12.6 feet, bearing S. 27° W..

[Latitude, 30° 57' 08''·57. Longitude, 98° 58' 10''·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	'	''	°	'	''	*Meters.*
B	309	08	42·88	129	10	28·96	3·849179
Antelope	157	01	39·00	336	57	33·99	4·597686
Onion Gap							4·656833
G	52	26	06·56	232	21	37·76	4·244123

B.

In northwest corner of Llano Co., Tex., on a light-colored gr hill, 16½ miles northwest of Llano, and 4 miles northeast of Smoo iron Mountain. "The lone oak" is one-fourth of a mile west. The a few live oak and mesquite trees on the hill. Station is on the h part of the hill. No trees near the station.

Permanent mark: Stone marked with a cross and U. S. G. S. 1

[Latitude, 30° 54' 38''·67. Longitude, 98° 52' 43''·77.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	'	''	°	'	''	*Meters.*
Riley Mountain	315	37	11·34	135	45	35·78	4·574120
Long Mountain	271	24	49·85	91	41	33·62	4·715322
Three Notch	129	10	28·96	309	08	42·88	3·849179
G	72	12	02·82	252	05	48·25	4·308871

D.

In San Saba Co., Tex. A light-colored gravelly hill, about 3 west from the twelfthmile post from San Saba court-house, on th Saba and Bluffton road north of Cherokee Creek.

Permanent mark: Cross and U. S. G. S. cut in rock, 20 feet N. 44° 14′ E. from center of station.

[Latitude, 31° 04′ 09″·8. Longitude, 98° 39′ 45″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Waters Mountain.	265	14	30·3	85	24	27·9	4·488997

WATERS MOUNTAIN.

In Lampasas Co., Tex., the southernmost of the knobs northwest of Lampasas; about one-half a mile from the tenth mile post from Lampasas. Local name, Waters or Green Mountain.

Permanent mark: Cross and U. S. G. S. cut in the rock 9·4 feet N. 22° 43′ E. from the signal tree.

[Latitude, 31° 05′ 31″·20. Longitude, 98° 29′ 27″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bunker Hill	344	42	40·22	164	44	09·88	4·243485
Long Mountain...	358	42	56·30	178	43	05·65	4·332659
Bachelor Peak ...	294	42	22·21	114	49	58·90	4·412687
Taylor Mountain .	271	41	38·29	91	53	21·78	4·557870
D	85	24	27·90	265	14	30·30	4·488997

BUNKER HILL.

In Burnet Co., Tex., about 200 yards west of the Burnet and San Saba road on the divide near the fourteenth mile post from Burnet. Instrument elevated 16 feet.

Permanent mark: Stone marked with a cross and U. S. G. S., N. 48° 46′ E., and distant 7.75 feet from station.

[Latitude, 30° 56′ 22″·45. Longitude, 98° 17′ 33″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Long Mountain...	41	56	43·81	221	55	23·73	3·791851
Waters Mountain	164	44	09·88	344	42	40·22	4·243485
Bachelor Peak....	252	08	57·18	72	15	03·33	4·297415

LONG MOUNTAIN.

In Llano Co., Tex., a cedar-covered hill 4 miles west of the thirteenth mile post from Burnet, on the Burnet and San Saba road. Station is near the northeast side of the hill. Local name is Long or Biñon Mountain. Instrument elevated 20 feet.

Permanent mark: Stone buried even with surface of ground, mar with a cross and U. S. G. S., S. 51° 36′ E., and distant 5.8 feet from station.

[Latitude, 30° 53′ 52″·98. Longitude, 98° 20′ 09″·43.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
B	91	41	38·62	271	24	49·85	4·715322
Bunker Hill	221	55	23·73	41	56	43·81	3·791851
Roper Hill	335	44	31·90	155	46	33·71	4·187025
Riley Mountain	45	26	18·69	225	18	02·81	4·558716
Waters Mountain	178	43	05·65	358	42	56·30	4·332659

BACHELOR PEAK.

In Lampasas Co., Tex.; a small butte about 8 miles south of pasas. The Georgetown and Lampasas road runs within one mile of the station on the west side. Station is S. 42° 56′ W. and tant 4·7 feet from the stone.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 59′ 39″·33. Longitude, 98° 05′ 42″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Waters Mountain	114	49	58·90	294	42	22·21	4·412687
Bunker Hill	72	15	03·33	252	08	57·18	4·297415
Prairie (1)	320	09	31·40	140	13	42·33	4·306436
Taylor Mountain	232	27	26·03	52	31	31·90	4·202526

HALEY RATLIF.

In Bell Co., Tex.; sometimes called Post Oak Mountain; a large k about 5 miles northeast of Florence post-office, covered with large oak trees. Land owned by Haley and Ratlif. Station is N. 75° 2 and distant 5 feet from the station. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 53′ 41″·15. Longitude, 97° 43′ 52″·40]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Taylor	133	14	37·11	313	07	28·36	4·481470
Prairie (1)	78	20	18·60	258	13	17·14	4·347953
Morrison Ridge	35	14	18·03	215	10	47·95	4·276423
Haystack	352	25	49·56	172	27	17·37	4·540935
Ivy Gap	146	29	23·10	326	25	08·21	4·376100
Temple	239	03	16·05	59	15	24·11	4·640355
Hulsey	197	34	20·51	17	37	02·71	4·441289

PRAIRIE (1).

In Burnet Co., Tex., on a high part of the prairie about 6 miles n from where the Bertram and Florence road crosses the San Ga River.

Permanent mark: Stone, marked with a cross and U. S. G. S. '85, buried a few inches under ground.

[Latitude, 30° 51′ 14″.17. Longitude, 97° 57′ 33″·71.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Taylor............	179	18	45·57	359	18	39·69	4·402518
Bachelor Peak....	140	13	42·33	320	09	31·40	4·306436
Haley Ratlif......	258	13	17·14	78	20	18·60	4·347953
Morrison Ridge...	314	55	06·15	134	58	36·80	4·188928

CORN HILL.

In Williamson Co., Tex., on the open prairie, 800 feet west of Corn Hill post-office, 335 feet south of a barbed wire fence.

Permanent mark: Stone, marked with a cross and U. S. G. S., buried about 2 inches under ground.

[Latitude, 30° 47′ 16″·37. Longitude, 97° 37′ 15″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haystack.........	14	53	09·21	194	51	14·17	4·368848
Beaver Hill.......	328	54	38·69	148	56	22·30	4·018871

MORRISON RIDGE.

In Williamson Co., Tex., about 8 miles northeast of Liberty Hill post-office—sometimes called Long Knob Station—on the west side, near the north end, and on about the highest part of the ridge; about 500 yards south from a well on the west side of the ridge. Land owned by J. C. Morrison. Signal stands near a post-oak tree, which has some limbs cut off on the east side.

Permanent mark: Stone marked with a cross and U. S. G. S. The station is S. 56° 40′ W. of stone and distant 5·05 feet.

[Latitude, 30° 45′ 19″·74. Longitude, 97° 50′ 42″·37.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haley Ratlif......	215	10	47·95	35	14	18·03	4·276423
Prairie (1).........	134	58	36·80	314	55	06·15	4·188928
Beaver Hill.......	281	11	53·88	101	20	29·93	4·437658
Haystack.........	320	47	00·77	140	51	57·52	4·389458

BEAVER HILL.

In Williamson Co., Tex., is a low, wooded hill about 8 miles northeast of Georgetown. Land owned by Henry Beach. About 400 yards east of "*the tree in the gap;*" west side of the hill.

Permanent mark: Stone marked with a cross and U. S. G. S., b
S. 71° 35′ E. 3·9 feet from center of station.

[Latitude, 30° 42′ 25″·88. Longitude, 97° 33′ 52″·51.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Morrison Ridge	101	20	29·93	281	11	53·88	4·437658
Corn Hill	148	56	22·30	328	54	38·69	4·018871
Haystack	39	53	27·95	219	49	49·74	4·250056
Yegua	318	12	10·83	138	23	37·64	4·733921

HAYSTACK.

In Williamson Co., Tex., on a bare hill about 3 miles south of Ge
town, about one-half mile east of the Georgetown and Round
road.

Permanent mark: Stone marked with a cross and U. S. G. S., b
under center of station.

[Latitude, 30° 35″ 02″·56. Longitude, 97° 41′ 00″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Beaver Hill	219	49	49·74	39	53	27·95	4·250056
Morrison Ridge	140	51	57·52	320	47	00·77	4·389458
Corn Hill	194	51	14·17	14	53	09·21	4·368848
Haley Ratlif	172	27	17·37	352	25	49·56	4·540935
Yegua	299	19	02·35	119	34	04·94	4·736688
P. K. N	7	05	23·23	187	04	49·19	4·161075

P. K. N.

In Travis Co., Tex.; on south end of hill known as Pilot Knob,
one mile northwest of Merrilltown; about three-fourths of a mil
of junction of the International and Great Northern and Austi
Northwestern railroads, which cross on land owned by W. G. McI

Permanent mark: Stone marked P. K. N., cross, and U. S. G. S

[Latitude, 30° 27′ 15″·59. Longitude, 97° 42′ 07″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haystack	187	04	49·19	7	05	23·23	4·161075
Yegua	284	00	55·12	104	16	29·89	4·706342
Texas Hill	335	06	04·26	155	11	05·98	4·679975
Lone Tree	34	45	45·97	214	42	32·58	4·253165

YEGUA.

In Lee Co., Tex.; is the most northerly of the Yegua knobs, 4¼
northeast of McDade, about 17 feet from the highest part of the h

Permanent mark: U. S. G. S. '84 and ⚠ cut in the rock 17 feet N. 1° 15′ E. from station.

[Latitude, 30° 20′ 31″·99. Longitude, 97° 11′ 20″·30.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Haystack	119	34	04·94	299	19	02·35	4·736698
Beaver Hill	138	23	37·64	318	12	10·83	4·783921
Bastrop Hill	26	03	16·94	205	59	37·89	4·423428
Texas Hill	56	38	14·43	236	27	45·20	4·602419
P. K. N	104	16	29·89	284	00	55·12	4·706342

BASTROP HILL.

In Bastrop Co., Tex., about 1 mile northeast of Bastrop court-house, on the westernmost of the Copperas Mountains.

Permanent mark: None.

[Latitude, 30° 07′ 38″·3. Longitude, 97° 18′ 35″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Yegua	205	59	37·89	26	03	16·94	4·423428
Lone Tree	114	17	16·68	294	02	13·28	4·720986

TEXAS HILL.

A bare, round-topped, gravelly hill, in Travis Co., Tex., about 1 mile south of Garfield post-office, about 15 miles from Austin and one-half mile north of the Upper Bastrop road; station on highest part of hill.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 08′ 35″·36. Longitude, 97° 32′ 09″·60.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lone Tree	127	05	50·40	306	57	36·79	4·516350
Yegua	236	27	45·20	56	38	14·43	4·602419
P. K. N	155	11	05·98	335	06	04·26	4·579975
Pilot Knob	95	53	52·16	275	48	45·17	4·215966
Bald Knob	166	18	28·08	346	16	50·41	4·340159
Cedar Hill	97	23	15·39	277	10	42·36	4·606632

EAST BASE HILL.

In Travis Co., Tex., on the east side of Onion Creek; a round-topped hill, about 130 feet above low water in the creek, about 1,380 feet east of East Base. The base line was extended by triangulation to this station. The line East Base Hill—West Base, is the line used as a base in the work around Austin. Instrument elevated 20 feet.

Permanent mark: Large stone, buried even with the surface ground and marked with the letters U. S. G. S. and copper bolt

[Latitude, 30° 11′ 48″·84. Longitude, 97° 36′ 32″·72.]

To station:	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Base........	94	37	26·11	....			2·625607
West Base........	94	37	26·11	274	34	12·90	4·013135
Pilot Knob........	65	24	59·85	245	22	04·88	4·010423
Bald Knob........	186	52	39·94	6	53	14·81	4·188397
Land Office.......	124	13	40·65	304	09	49·00	4·172615

BALD KNOB.

A round, bare, grassy knob in Travis Co., Tex., near the 1 board from Austin, on the Austin and Manor road, between the road and the railroad, about 3 miles from Manor station and highest part of the hill.

Permanent mark: Stone marked with a cross.

[Latitude, 30° 20′ 05″·87. Longitude, 97° 35′ 23″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Texas Hill........	346	16	50·41	166	18	28·08	4·340159
Pilot	29	41	42·49	209	38	12·31	4·352942
East Base Hill....	6	53	14·81	186	52	39·94	4·188397

LAND OFFICE.

In Travis Co., Tex., on the peak of the roof of the land of Austin, on the south end and just north of the north chimney.

Permanent mark: None.

[Latitude, 30° 16′ 19″·93. Longitude, 97° 44′ 13″·02.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Base Hill ...	304	09	49·0	124	13	40·65	4·172615

LONE TREE (1).

A flat-topped hill on the south side of the Colorado River, in Co., Tex., about 5 miles northwest from Austin and about 2½ west from Mount Bonnell. All the large trees except one hav cut from the hill. Wood road leading to Austin passes the hill south side.

Permanent mark: A 2 by 4 joist spiked to the roots of a tree bears S. 15° W. from the center of the station, 8·7 feet distant; has a △ cut on it.

[Latitude, 30° 19′ 17″·54. Longitude, 97° 48′ 29″·95.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
P. K. N	214	42	32·58	34	45	45·97	4·253165
Cedar Hill	43	26	06·50	223	21	45·40	4·304545
Bastrop Hill	294	02	13·28	114	17	16·68	4·720986
Shingle	85	55	23·58	265	46	44·41	4·440203
Boultinghouse	134	33	55·67	314	25	23·96	4·577263
Pilot Knob	331	21	57·91	151	25	03·82	4·314154
Texas Hill	306	57	36·79	127	05	50·40	4·516350

WEST BASE.

In Travis Co., Tex., about 5 miles southeast of Austin, in the north corner of a field belonging to T. P. Givens, and about 100 feet south of his house. Instrument elevated 20 feet.

Permanent mark: Large stone buried 6 inches under the surface, 5 feet from fence, marked U. S. G. S., W. B.; center is a copper bolt marked with a cross.

[Latitude, 30° 12′ 15″·17. Longitude, 97° 42′ 56″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pilot Knob	349	16	42·70	169	17	00·81	3·714471
East Base Hill	274	34	12·90	94	37	26·11	4·013135

PILOT KNOB.

In Travis Co., Tex.; it is the south one of two bare hills known as the Pilot Knobs, about 8 miles south of Austin, on land owned by William (or "Wildcat") Jones.

Permanent mark: Stone monument, about 4 feet high and 5 feet in diameter at the base.

[Latitude, 30° 09′ 29″·83. Longitude, 97° 42′ 20″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Knob	209	38	12·31	29	41	42·49	4·352942
Texas Hill	275	48	45·17	95	53	52·16	4·215966
Lone Tree	151	25	03·82	331	21	57·91	4·314154
East Base Hill	245	22	04·88	65	24	59·85	4·010423
West Base	169	17	00·81	349	16	42·70	3·714471

CEDAR HILL.

In Travis Co., Tex., about 14 miles west of Austin and 2 miles south of Cedar Valley post-office on a wooded hill. Station is on the part of the hill owned by Mr. Fred Willis, and is about the center of the hill. Instrument elevated 31 feet.

Permanent mark: Stone marked Cedar Hill with a cross and U. S. G. S.

[Latitude, 30° 11′ 21″·78. Longitude, 97° 57′ 08″·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Shingle	132	52	43·30	312	48	26·18	4·269803
Lone Man	46	00	13·41	225	56	10·94	4·254805
Texas Hill	277	10	42·36	97	23	15·39	4·606632
Lone Tree (1)	223	21	45·40	43	26	06·50	4·304545

LONE MAN.

In Hays Co., Tex. A small peak 8 miles south of Dripping Springs near the intersection of the Dripping Springs and San Marcos, and the Blanco and Kyle roads. Local náme, Lone Man. Station is N. 23° 49′ E., and distant 4·9 feet from stone.

Permanent mark: Stone marked with a cross and U. S. G. S., 1884.

[Latitude, 30° 04′ 35″·92. Longitude, 98° 05′ 11″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Twin Sisters	72	53	46·00				
Cedar Hill	225	56	10·94	46	00	13·41	4·254805
Shingle	178	19	44·98	358	19	31·17	4·400782

TWIN SISTERS.

In Blanco Co., Tex., the westernmost of two buttes, near Twin Sisters post-office, 6½ miles south of Blanco.

Permanent mark: Stone marked with a cross.

[Latitude, 29° 58′ 48″·7. Longitude, 98° 26′ 40″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Shovel Mountain				20	31	35	4·737288
Lone Man				72	53	46	

SHINGLE.

In Hays Co., Tex. A butte at the west end of Shingle Mountain. The station is near the northwest side of the butte. The Cedar Valley and Round Mountain post-office road runs one-fourth mile east of the station.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 18′ 12″·80. Longitude, 98° 05′ 38″·58.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	Meters.
Boultinghouse	181	00	01·81	1	00	11·26	4·454476
Shovel	136	22	15·20	316	17	38·36	4·325789
Round Mountain	122	27	42·08	302	19	26·84	4·490882
E	76	01	39·76	255	51	07·67	4·538560
Lone Man	358	19	31·17	178	19	44·98	4·400782
Lone Tree	265	46	44·41	85	55	23·58	4·440203
Cedar Hill	312	48	26·18	132	52	43·30	4·269803

E.

In Blanco Co., Tex., on a high, round-topped bare hill, about 4 miles south of Johnson City, south side of the Austin and Fredericksburg road.

Permanent mark: Stone marked with a cross and U. S. G. S. '85.

[Latitude, 30° 13′ 40″·14. Longitude, 98° 28′ 32″·70.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shingle	255	51	07·67	76	01	39·76	4·538560
Round Mountain	196	21	14·29	16	23	33·12	4·415656

SHOVEL.

In Blanco Co., Tex., a high flat-topped butte 6 miles east of Round Mountain post-office, in a pasture owned by Abling Brothers. Local name is Shovel Mountain. Station is S. 58° 33′ E., and distant 9 feet from the mark.

Permanent mark: Stone marked with a cross and U. S. G. S. 1885.

[Latitude, 30° 26′ 30″·19. Longitude, 98° 14′ 46″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boultinghouse	228	53	35·34	48	58	22·71	4·301581
Shingle	316	17	38·36	136	22	15·20	4·325789
Twin Sisters	20	31	35·00	....			4.737288

BOULTINGHOUSE.

In Burnet Co., Tex., on point of ridge facing west about 3 miles from the Colorado river, 37 miles from Austin on the old Austin and Burnet road, on land owned by Mr. Boultinghouse.

Permanent mark: U. S. G. S. cut in rock near station. Center marked by a duplicate + cut in rock about 4 feet from letters.

[Latitude, 30° 33′ 37″·40. Longitude, 98° 05′ 19″·93.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Round Mountain	66	00	29·96	245	52	03·36	4·464533
Roper Hill	143	29	41·31	323	24	08·85	4·464468
Shovel	48	58	22·71	228	53	35·34	4·301581
Lone Tree	314	25	23·96	134	33	55·67	4·577263
Shingle	1	00	11·26	181	00	01·81	4·454476

ROUND MOUNTAIN.

In Blanco Co., Tex., a small, round knob 3 miles northwest of Round Mountain post-office. Local name Round Mountain. Station is N. 84° 36′ E., distant 6·3 feet from the mark.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 27′ 11″·52. Longitude, 98° 21′ 57″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Roper Hill	194	36	57·44	14	39	53·69	4·561987
E	16	23	33·12	196	21	14·29	4·415656
Bell Mountain	88	49	41·39	268	39	01·71	4·527442
Riley Mountain	136	13	37·04	316	06	19·54	4·519961
Shingle	302	19	26·84	122	27	42·08	4·490882
Boultinghouse	245	52	03·36	66	00	29·96	4·464533

ROPER HILL.

In Burnet Co., Tex., on a ridge about 3 miles west of Burnet. Burnet and Llano road passes near foot of the ridge, distant about half mile from the station. Station is near a live oak tree which had most of the limbs cut off. On highest part of the ridge. T is an old stone quarry about one-half mile from station toward Bu Instrument elevated 16 feet. Station is S. 76° 41′ W. from stone, tant 5.15 feet.

Permanent mark: Stone marked with a cross and U. S. G. S., 1

[Latitude, 30° 46′ 17″·52. Longitude, 98° 16′ 11″·78.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Riley Mountain	70	31	31·88	250	21	15·52	4·532351
Long Mountain	155	46	33·71	335	44	31·90	4·187025
Boultinghouse	323	24	08·85	143	29	41·31	4·464468
Round Mountain	14	39	53·69	194	36	57·44	4·561987

RILEY MOUNTAIN.

In Llano Co., Tex., on the highest knob near the northeastern of Riley Mountain, sometimes called Dancer Peak.

Permanent mark: A cross and U. S. G. S. '85 is cut in the N. 7° 52′ E., and distant 13 feet from station.

[Latitude, 30° 40′ 07″·12. Longitude, 98° 36′ 18″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Long Mountain	225	18	02·81	45	26	18·69	4·558716
B	135	45	35·78	315	37	11·34	4·574120
Bell Mountain	23	31	49·39	203	28	25·11	4·428989
House	74	26	52·76	254	17	17·14	4·494748
Roper Hill	250	21	15·52	70	31	31·88	4·532351
Round Mountain	316	06	19·54	136	13	37·04	4·519961

BELL MOUNTAIN.

A high, bare hill, in Gillespie Co., Tex., about 5 miles northwe Hudson mound. The station is about fifty feet from eastern ed the hill. Sometimes called Not Mountain.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 26′ 47″·45. Longitude, 98° 43′ 00″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
House Mountain..	129	54	48·84	309	48	40·15	4·402872
Round............	268	39	01·71	88	49	41·39	4·527442
Riley Mountain ..	203	28	25·11	23	31	49·39	4·428989

HOUSE MOUNTAIN.

A flat-topped granite butte in Llano Co., Tex., about 20 miles southwest of Llano court-house. Station is near the north edge of the butte and on the highest part.

Permanent mark: Cross and U. S. G. S. cut in the highest rock on the mountain S. 0° 32′ W. and 20 feet from center.

[Latitude, 30° 35′ 33″·74. Longitude, 98° 55′ 08″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bell Mountain	309	48	40·15	129	54	48·84	4·4028720
Riley Mountain ..	254	17	17·14	74	26	52·76	4·4947480
Blue Mountain ...	86	52	49·54	266	36	55·66	4·6993160
G.................	151	48	48·79	331	43	49·69	4·5176159

BLUE MOUNTAIN.

In Kimble Co., Tex., on highest knob of Blue Mountain, 5 miles south of Llano River and about 20 miles west of Mason.

Permanent mark: Stone marked U. S. G. S. 86 and cross. Distance to center, 8·5 feet, bearing N. 29° W.

[Latitude, 30° 34′ 01″·56. Longitude, 99° 26′ 23″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
House Mountain..	266	36	55·66	86	52	49·54	4·699316
G	227	02	15·64	47	13	14·22	4·670432
Mason Mountain..	214	07	56·84	34	14	49·22	4·582486

PEAK.

In Menard Co., Tex. (not occupied), on the eastern of two peaks in the southeast part of the Los Meras ranch, about one-half mile from the eastern fence, in a large cattle pasture.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 45′ 21″·64. Longitude, 99° 41′ 42″·07.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cactus.............	106	30	10·20	286	23	01·26	4·366105
Maddox	168	27	17·84	348	24	59·09	4·553546

RUNGE.

In Menard Co., Tex. (not occupied), in the Los Meras ranch and about 4 miles south of Menardsville, about 3 miles a little north of east from Mr. Runge's residence, on the highest point of, and near the northern edge of the ridge. A large live-oak tree was cut down about 100 yards southeast of signal.

Permanent mark: None.

[Latitude, 30° 51′ 35″·49. Longitude, 99° 46′ 26″·47.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cactus	71	29	36·59	251	24	52·78	4·190867
Mustang	143	09	04·19	323	04	09·03	4·404422
Sumac	14	15	17·35	194	14	01·99	4·201578

MUSTANG.

In Menard Co., Tex., about 1 mile southeast from Mr. Sim's windmill on the Eden and McKavett road and about 12 miles from Eden. About three-fourths of a mile east of Niggers Gap. All timber cleared away except one mesquite tree.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 02′ 34″·52. Longitude, 99° 56′ 00″·35.]

To station.	Azimuth.			Back azimuth.			Log. dist
	°	′	″	°	′	″	*Meters.*
Molloy	195	07	13·69	15	09	37·94	4·451199
Maddox	258	13	42·43	78	18	45·89	4·202166
Runge	323	04	09·03	143	09	04·19	4·404422
Cactus	358	46	46·34	178	46	56·74	4·402042
Burbank	26	27	14·28	206	22	40·11	4·503129
First	45	32	32·77	225	27	24·49	4·348071
Flower	111	01	21·08	290	56	37·72	4·192866

BONES.

In Menard Co., Tex., near the McCullough line, about 3 miles north of the Menardville and Brady road, at a point about 8 miles from Menardville, in the southeast corner of Maddox's pasture, on the highest and most northern of three high points.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 00′ 31″·31. Longitude, 99° 39′ 17″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Maddox	122	38	16·96	302	34	43·21	4·115598
Live Oak	179	28	59·53	359	28	54·07	4·490477

MADDOX.

In Menard Co., Tex., in a pasture owned by Mr. Maddox, of Austin, 2 or 3 miles south of the Concho line, about 2½ miles east of Eden and Menardville road, and 1 mile a little south of east of the ranch house, about one-fourth of a mile south of the road between Mr. Maddox's two ranches; 9 miles from Eden to Maddox's gate. Instrument elevated 24 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 31° 04′ 19″·66. Longitude, 99° 46′ 12″·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Molloy	161	12	01·55	341	09	21·32	4·404850
Live Oak	204	04	49·90	24	08	19·05	4·418098
Bones	302	34	43·21	122	38	16·96	4·115598
Peak	348	24	59·09	168	27	17·84	4·553546
Mustang	78	18	45·89	258	13	42·43	4·202166
Cactus	27	56	45·59	207	51	53·53	4·508065

FIRST.

In Menard Co., Tex., on western side of the county and about 4 miles a little east of north from Fort McKavett, on the most western of three prominent knolls.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 54′ 07″·25. Longitude, 100° 05′ 59″·39.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Burbank	352	19	34·01	172	20	08·43	4·1146200
Black	64	34	04·58	244	27	42·14	4·3413280
Cactus	300	14	47·14	120	20	04·77	4·2799860
Mustang	225	27	24·49	45	32	32·77	4·3480710
Fort McKavett	5	51	34·93	185	51	18·87	3·9110093

BLACK.

In Schleicher Co., Tex., in Mr. Black's pasture, about 12 miles west from Fort McKavett, on high knoll on divide between the north valley and middle valley of the San Saba River. The ranch road running west from Fort McKavett passes about 2 miles north of station.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 49′ 00″·64. Longitude, 100° 18′ 24″·99.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
First	244	27	42·14	64	34	04·58	4·341328
Burbank	279	03	49·03	99	10	44·30	4·339168
Decker	314	51	25·18	134	56	57·96	4·388314
Riley	343	58	50·26	164	00	35·38	4·297740

FORT MᶜKAVETT.

In Menard Co., Tex. Not occupied. Located in 1891. Tower on old building.

[Latitude, 30° 49′ 44″·07. Longitude, 100° 06′ 30″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
First	185	51	18·87	5	51	34·93	3·9110093
Burbank	331	49	18·89	151	50	08·41	3·7859203

CACTUS.

In Menard Co., Tex., on the Los Meras ranch, owned by Mr. Runge, about 6 miles a little south of west from Mr. Runge's residence. No other house near. The highest point within 4 or 5 miles, about one-half mile south of a fence. Timber all cleared from summit.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 48′ 55″·20. Longitude, 99° 55′ 40″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mustang	178	46	56·74	358	46	46·34	4·402042
Maddox	207	51	53·58	27	56	45·59	4·508065
Burbank	77	25	55·64	257	21	12·03	4·178635
First	120	20	04·77	300	14	47·14	4·279986
Runge	251	24	52·78	71	29	36·59	4·190867
Peak	286	23	01·26	106	30	10·20	4·366105
Deer	23	01	11·10	202	59	47·96	4·043674
Sumac	314	05	23·90	134	08	51·82	4·177721

DEER.

In Menard Co., Tex. Not occupied. About 4 miles west of the Menardville and Junction City road, where road goes off the divide between Los Meras and Bear creeks, on the highest and most southern of several hills at the head of Los Meras Creek.

Permanent mark: None.

[Latitude, 30° 43′ 24″·09. Longitude, 99° 58′ 22″·66.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cactus	202	59	47·96	23	01	11·10	4·043674
Sumac	271	06	26·02	91	11	16·69	4·180165

SUMAC.

In Menard Co., Tex. Not occupied. In the Los Meras pasture about 3 miles east of Menardville and Junction City road, where it goes off the divide between Los Meras and Bear creeks, about 10 miles from

Mr. Runge's house; south, a little east, about 50 yards from the fence on the west side of the pasture. Platform 15 feet high.

[Latitude, 30° 43′ 14″·84. Longitude, 99° 48′ 53″·68.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cactus	134	08	51·82	314	05	23·90	4·177721
Runge	194	14	01·99	14	15	17·35	4·201578
Deer	91	11	16·69	271	06	26·02	4·180165

BURBANK.

In Mr. Burbank's north pasture on high knoll in the western side of Menard Co., Tex., about 2 miles southwest of Mr. Burbank's residence and 1 mile east from the McKavett and Pecan Spring road, about 3 miles a little east of south from Fort McKavett.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 47′ 08″·23. Longitude, 100° 04′ 54″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
First	172	20	08·43	352	19	34·91	4·114620
Cactus	257	21	12·03	77	25	55·64	4·178635
Mustang	206	22	40·11	26	27	14·28	4·503129
Black	99	10	44·30	279	03	49·03	4·339168
Decker	17	08	51·52	197	07	29·82	4·159582
Fort McKavett	151	50	08·41	331	49	18·89	3·735920

DECKER.

In Sutton Co., Tex., in northeast corner of the county, in a cedar grove about 50 yards south of the McKavett and Pecan Spring road and about 6 miles north from Pecan Spring. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 39′ 40″·12. Longitude, 100° 07′ 38″·92.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black	134	56	57·96	314	51	25·18	4·388314
Burbank	197	07	29·82	17	08	51·52	4·159582
Riley	81	18	41·36	261	14	54·30	4·079046
Patterson	342	20	42·07	162	23	19·67	4·435987
Piper	32	01	19·12	211	58	49·26	4·170156

RILEY.

In Sutton Co., Tex. Cupola on Mr. John Riley's residence, about 12 miles south of Fort McKavett.

Permanent mark: Cupola.

[Latitude, 30° 38′ 41″·06. Longitude, 100° 14′ 59″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black	164	00	35·38	343	58	50·26	4·297740
Decker	261	14	54·30	81	18	41·36	4·079046
Piper	339	26	12·27	159	27	29·13	4·059128
Wentworth	22	02	04·68	201	59	12·26	4·382546

PIPER.

In Sutton Co., Tex., on highest point on mountain about half west from west side of Mr. John Riley's pasture. Old Fort road is about one-quarter of a mile east of station; about 2 little east of north from Mr. Adams' windmill. Instrument el 16 feet.

[Latitude, 30° 32′ 52″·64. Longitude, 100° 12′ 28″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Riley	159	27	29·13	339	26	12·27	4·059128
Decker	211	58	49·26	32	01	19·12	4·170156
Patterson	309	48	45·88	129	53	52·56	4·322236
Marshall	358	21	16·47	178	21	27·72	4·314714
Wentworth	48	21	10·11	228	17	01·32	4·243193

WENTWORTH.

Situated in Sutton Co., Tex., on a ridge about 12 miles wes Mr. Wentworth's residence, which is at the head of the running of the north fork of Llano River, about 2 miles northwest fr 10-mile water hole on North Llano. Several large live-oak tr near the station. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 26′ 34″·59. Longitude, 100° 20′ 38″·55.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Piper	228	17	01·32	48	21	10·11	4·243193
Marshall	303	16	37·70	123	20	57·04	4·214026
Fawn	341	25	39·89	161	27	15·90	4·202208
Wallace	28	41	44·99	208	38	22·92	4·347516
Riley	201	59	12·26	22	02	04·68	4·382546

PATTERSON.

Situated in Kimble Co., Tex., on a high prairie knoll near on the eastern side of Mr. Patterson's pasture, and about 3 mil of his residence, which is near the head of Maynard Creek, three-quarters of a mile east of old government road betwee McKavett and Fort Clark.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 25′ 35″·59. Longitude, 100° 02′ 23″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Piper	129	53	52·56	309	48	45·88	4·322236
Decker	162	23	19·67	342	20	42·07	4·435978
Marshall	65	16	08·26	245	11	13·66	4·233497

MARSHALL.

Situated in Sutton Co., Tex., on Messrs. Marsh & Taylor's pasture, about one-quarter of a mile east from the west side of the pasture and about 1 mile south from the north side. It is on a very flat ridge which is the divide between the north and south branches of the Llano River, about 3 miles northwest from Marsh & Taylor's ranch. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 21′ 42″·64. Longitude, 100° 12′ 06″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Piper	178	21	27·72	358	21	16·47	4·314714
Patterson	245	11	13·66	65	16	08·26	4·233497
Wentworth	123	20	57·04	303	16	37·70	4·214026
Fawn	54	40	38·91	234	37	55·99	4·023819
Harris	354	22	41·15	174	23	20·95	4·333607

FAWN.

Situated in Edwards Co., Tex., on ridge about 2 miles west from the west side of Mr. Wentworth's small pasture, which joins Marsh & Taylor's pasture on the east side; about 1 mile northwest of Mr. Runnels' wind-mill; 1 mile south from the Sutton County line. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 18′ 24″·18. Longitude, 100° 17′ 28″·67.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wentworth	161	27	15·90	341	25	39·89	4·202208
Marshall	234	37	55·90	54	40	38·91	4·023819
Harris	324	59	30·77	145	02	52·96	4·272445
Fire	353	54	16·74	173	55	05·88	4·391543
Wallace	74	20	35·25	254	15	37·83	4·214082

WALLACE.

Situated in Edwards Co., Tex., on a prairie ridge about 4 miles southwest from Mr. Thomas Rand's residence. Road between Mr.

Rand's and Mr. Hagerman's ranches passes about one-half mil from the station. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S

[Latitude, 30° 16′ 00″·33. Longitude, 100° 27′ 18″·40.]

To stations.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Wentworth	208	38	22·92	28	41	44·90	4·347516
Fawn	254	15	37·83	70	20	35·25	4·214082
Harris	292	18	26·48	112	26	45·35	4·457398
Fire	317	26	41·62	137	32	27·16	4·434878
Wolf	339	10	20·77	159	13	03·00	4·385990

HARRIS.

Situated in Edwards Co., Tex., on a ridge about 1½ miles s Harris post-office. A grove of live-oak trees about 100 yards west of station. A thicket of small trees on east and west station. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 10′ 05″·90. Longitude, 100° 10′ 47″·16.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wallace	112	26	45·35	292	18	26·48	4·457398
Fawn	145	02	52·96	324	59	30·77	4·272449
Fire	41	38	46·35	221	36	13·89	4·087909
Marshall	174	23	20·95	354	22	41·18	4·333607
Jasper	17	26	49·69	197	25	04·84	4·271688

FIRE.

Situated in Edwards Co., Tex., on a live-oak ridge about 4 mil from McKenzie Lake and Rock Springs road where the road cros divide south of McKenzie Lake. Road from McKenzie Lake to Water Hole, at a point 5 miles from McKenzie Lake, passes wit yards of the station. Instrument elevated 20 feet.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 30° 05′ 08″·67. Longitude, 100° 15′ 50″·98.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wallace	137	32	27·16	317	26	41·62	4·434878
Harris	221	36	13·85	41	38	46·35	4·087909
Wolf	74	44	01·14	254	40	58·45	4·005284
Jasper	343	42	21·79	163	43	09·20	3·956438
Fawn	173	55	05·88	353	54	16·74	4·391543

WOLF.

Situated in Edwards Co., Tex., on ridge about 2 miles northea Mr. Ridley's windmill. Road running west from Rock Spring

200 yards south of station at a point about 12 miles from Rock
s. Instrument elevated 20 feet.
nanent mark: None.

[Latitude, 30° 03′ 41″·97. Longitude, 100° 21′ 56″·55.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wallace	159	13	03·00	339	10	20·77	4·385990
Fire	254	40	58·45	74	44	01·14	4·005284
Ellis	17	30	16·27	197	27	08·69	4·526210
Jasper	296	00	39·14	116	04	29·01	4·136582
Holliday	344	59	04·03	165	00	31·22	4·256860

JASPER.

ated in Edwards Co., Tex., on a live-oak ridge about 1¾ miles
f the town of Rock Springs. Road from Rock Springs to Ford &
ay's ranch passes one-half mile north of station. Instrument
d 20 feet.
nanent mark: None.

[Latitude, 30° 00′ 26″·69. Longitude, 100° 14′ 16″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wolf	116	04	29·01	296	00	39·14	4·136582
Fire	163	43	09·20	343	42	21·79	3·956438
Harris	197	25	04·84	17	26	49·69	4·271688
Goode	10	00	20·52	189	58	46·87	4·463488
Holliday	33	45	04·62	213	42	42·41	4·138375

HOLLIDAY.

ated in Edwards Co., Tex., on the highest point on a ridge
4 miles southwest from Ford & Holliday's ranch. Road from
Springs to Blackwater Hole passes about 1½ miles north of
, at a point about 10 miles from Rock Springs.
nanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 29° 54′ 15″·25. Longitude, 100° 19′ 01″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wolf	165	00	31·22	344	59	04·03	4·256860
Jasper	213	42	42·41	33	45	04·62	4·138375
Reagan	324	40	48·88	144	44	34·46	4·323848
Goode	351	23	51·59	171	24	39·74	4·240302
Ellis	45	24	39·03	225	20	05·09	4·317387

ELLIS.

ated in Edwards Co., Tex., on high point on mountain, about 2
a little south of west of Ellis post-office, which is at the resi-
of Mr. Jerry Ellis.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 29° 46′ 21″·43. Longitude, 100° 28′ 11″·65.].

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wolf	197	27	08·69	17	30	16·27	4·526210
Holliday	225	20	05·09	45	24	39·03	4·317387
Goode	278	28	33·21	98	33	54·55	4·245180
Nueces	320	20	14·75	140	24	22·67	4·324095

GOODE.

Situated in Edwards Co., Tex., on a high point on a divide a
miles east of Kickapoo Spring, which is on road between Rock S
and Fort Clark, and about 35 miles from Fort Clark; about 6 mil
of the head of Cedar Creek.

Permanent mark: Stone marked with a cross and U. S. G. S

[Latitude, 29° 44′ 56″·80. Longitude, 100° 17′ 24″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ellis	98	33	54·55	278	28	33·21	4·245180
Holliday	171	24	39·74	351	23	51·59	4·240302
Jasper	189	58	46·87	10	00	20·52	4·463488
Reagan	270	02	27·34	90	05	24·35	3·981609
Monte	337	14	57·08	157	17	36·13	4·349757
Nueces	16	10	07·36	196	08	54·57	4·152272

REAGAN.

Situated in Edwards Co., Tex., on the most eastern of two high
covered knolls; on the south side and near the head of Cedar C

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 29° 44′ 56″·45. Longitude, 100° 11′ 27″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Goode	90	05	24·35	270	02	27·34	3·981609
Holliday	144	44	34·46	324	40	48·88	4·323848
Monte	2	38	15·53	182	37	58·06	4·314879
Nueces	44	51	22·03	224	47	12·55	4·283584

NUECES.

Situated in Edwards Co., Tex., on a large lone mountain, about
north from Mr. Hillcote's ranch (post-office) and about 3 miles
east from a spring known as Dobbs Run, on the West Nueces R

[Latitude, 29° 37′ 33″·84. Longitude, 100° 9′ 51″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	″	″	*Meters.*
Ellis	140	24	22·67	320	20	14·75	4·324095
Goode	196	08	54·57	16	10	07·36	4·152272
Reagan	224	47	12·55	44	51	22·03	4·283584
Monte	299	00	26·41	119	04	17·74	4·158905
Turkey	335	14	51·52	155	18	51·52	4·486057
Anacacho	354	54	35·34	174	55	54·13	4·689033
Las Moras	10	25	48·29	190	24	08·76	4·478883

MONTE.

dwards Co., Tex., on a sharp peak in the southern part nty, near the Kinney County line, about 3½ miles northr post-office. The Whistler and Barksdale road passes st of the station.

ark: Stone marked with a cross and U. S. G. S.

[Latitude, 29° 33′ 46″·53. Longitude, 100° 12′ 02″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
ueces	119	04	17·74	299	00	26·41	4·158905
oode	157	17	36·13	337	14	57·08	4·349757
urkey	359	28	43·62	179	28	47·08	4·318473
eagan	182	37	58·06	2	38	15·53	4·314879
uacacho	11	17	24·35	191	14	53·30	4·628365
as Moras	38	39	23·45	218	33	53·64	4·461748

TURKEY.

Kinney Co., Tex., on a lone mountain, about 16 miles a east from Fort Clark. Point is well known.

ark: Stone marked with a cross and U. S. G. S.

[Latitude, 29° 22′ 30″·25. Longitude, 100° 11′ 55″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
as Moras	84	23	45·81	264	18	13·51	4·263989
onte	179	28	47·08	359	28	43·62	4·318473
nacacho	22	11	46·58	202	09	12·53	4·352677
ueces	155	18	45·64	335	14	51·52	4·486057
ort Clark	70	47	06·90	250	40	38·65	4·354939

LAS MORAS.

Kinney Co., Tex., on a large, lone mountain, known as k, about 4 miles northeast of Fort Clark.

ark: Rock cairn.

[Latitude, 29° 21′ 31″·62. Longitude, 100° 23′ 13″·43.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
ueces	190	24	08·76	10	25	48·29	4·478883
onte	218	33	53·64	38	39	23·45	4·461748
urkey	264	18	13·51	84	23	45·81	4·263989
nacacho	332	46	42·24	152	49	39·56	4·330812
line	305	57	05·70	126	04	18·75	4·470519
pofford	6	01	17·44	136	00	38·68	4·310132

FORT CLARK.

Situated in Kinney Co., Tex.; not occupied.

Permanent mark: Flagstaff.

[Latitude, 29° 18′ 27″·65. Longitude, 100° 25′ 08″·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Turkey	250	40	38·65	70	47	06·90	4·354939
Anacacho	316	03	08·97	136	07	02·20	4·269139

CLINE.

In Kinney Co., Tex., on the southeast side of the Anacacho M
ains, about 4 miles southwest of Cline post-office; very near the e
side of the mountains.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 29° 12′ 07″·36. Longitude, 100° 08′ 28″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Anacacho	83	15	20·51	263	11	05·51	4·152988
Las Moras	126	04	18·75	305	57	05·70	4·470519

ANACACHO.

Situated in Kinney Co., Tex., on a high knoll on the west s
the Anacacho Mountains, about 1 mile south from a station c
Southern Pacific Railroad known as Anacacho, very near the no
side of the mountain.

Permanent mark: Stone marked with a cross and U. S. G. S.

[Latitude, 29° 11′ 12″·82. Longitude, 100° 17′ 10″·78.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Las Moras	152	49	39·56	332	46	42·24	4·330812
Turkey	202	09	12·53	22	11	46·58	4·352677
Nueces	174	55	54·13	354	54	35·34	4·689033
Monte	191	14	53·30	11	17	24·35	4·628365
Cline	263	11	05·51	83	15	20·51	4·152988
Spofford	84	00	29·35	263	56	53·88	4·079441
Fort Clark	136	07	02·20	316	03	08·97	4·269139

SPOFFORD (WATER TANK).

In Kinney Co., Tex. Not occupied. Water tank. Located in

[Latitude, 29° 10′ 31″·91. Longitude, 100° 24′ 32″·72.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Las Moras	186	00	38·68	6	01	17·44	4·3101324
Anacacho	263	56	53·88	84	00	29·35	4·0794410

CORNUDA.

Co., N. Mex., just north of Texas State line and about 2 om the Cornuda Mountain and Spring, on what is locally nd Mountain.

mark: Conical pile of rocks 5 or 6 feet in height on highe ntain.

[Latitude, 32° 01′ 28″·44. Longitude, 105° 30′ 57″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Salt	324	44	31·51	144	56	10·27	4·7822428
Quitman	358	54	54·94	178	55	31·28	4·9871645
North Franklin	81	53	27·32	261	22	24·88	4·9702455
El Capitan	283	18	38·13	103	39	26·18	4·8039810
Cerro Alto	78	26	22·02	258	11	54·71	4·6424226

NORTH FRANKLIN.

t point of Franklin range of mountains in El Paso Co., 10 or 12 miles north from town of El Paso.

mark: Conical pile of stones 7 or 8 feet in height.

[Latitude, 31° 54′ 07″·24. Longitude, 106° 29′ 35″·83.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cornuda	261	22	24·88	81	53	27·32	4·9702455
Quitman	311	09	02·18	131	40	18·08	5·1010737

ler survey determined location of this point from astro- ion at El Paso and a short base line near El Paso. The given are: Latitude, 31° 54′ 06″·81; longitude, 106° 29′

CERRO ALTO.

t point of Cerro Alto Mountain in El Paso Co., Tex., about t of town of El Paso.

t mark: Conical pile of rocks.

[Latitude, 31° 56′ 39″·90. Longitude, 105° 58′ 15″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cornuda	258	11	54·71	78	26	22·02	4·6424226
Quitman	332	49	48·76	153	04	41·76	4·9956792

EL CAPITAN.

o Co., Tex., on highest point of Guadalupe Mountains and ghest point in Texas.

Permanent mark: Conical pile of rocks.

[Latitude, 31° 53′ 26″·38. Longitude, 104° 51′ 39″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Salt	38	09	27·15	218	00	24·34	4·6438946
Cornuda	103	39	26·18	283	18	38·13	4·8039810

SALT.

In El Paso Co., Tex., on highest point of small isolated ra mountains, known as Sierra Prietta, about 35 miles northeas Sierra Blanca.

Permanent mark: Top of culminating rock.

[Latitude, 31° 34′ 40″·74. Longitude, 105° 08′ 51″·69.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Eagle	355	20	35·69	175	22	31·67	4·8640142
Quitman	35	01	10·05	214	50	16·04	4·7634401
Cornuda	144	56	10·27	324	44	31·51	4·7822428
El Capitan	218	00	24·34	38	09	27·15	4·6438946

SIERRA BLANCA.

In El Paso Co., Tex., on northern of two points of Sierra Peak.

Permanent mark: Conical pile of rocks about 6 or 8 feet high.

[Latitude, 31° 15′ 05″·34. Longitude, 105° 26′ 09″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mesa	298	07	27·64	118	16	14·40	4·4851764
Quitman	27	01	38·84	206	59	45·58	4·1053004
Diablo	276	44	59·51	97	01	12·65	4·6903709
Chispa	305	30	59·56	125	53	26·69	4·9312553
Eagle	317	33	17·14	137	44	08·48	4·6957501

QUITMAN.

In El Paso Co., Tex., on highest point of Quitman Mountains.

Permanent mark: Pile of rocks about 6 feet in height.

[Latitude, 31° 08′ 56″·68. Longitude, 105° 29′ 48″·26.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mesa	275	17	51·58	95	28	30·60	4·5170143
Eagle	302	43	14·90	122	55	58·00	4·6694309
North Franklin	131	40	18·08	311	09	02·18	5·1010737
Cornuda	178	55	31·28	358	54	54·94	4·9871645
Salt	214	50	16·04	35	01	10·05	4·7634401
Cerro Alto	153	04	41·76	332	49	48·76	4·9956792
Sierra Blanca	206	59	45·58	27	01	38·84	4·1053004

DIABLO.

On eastern of two high points in Diablo Mountains, in El Paso Co., Tex., about 3 miles northwest from Hazel silver mines and about 30 miles southeast from Sierra Blanca.

Permanent mark: Conical pile of rocks with cedar tree in center.

[Latitude, 31° 11′ 50″·54. Longitude, 104° 54′ 52″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sierra Blanca	97	01	12·65	276	44	59·51	4·6903709
Eagle	28	03	51·05	207	58	33·38	4·5409601
Chispa	335	55	12·13	156	01	31·35	4·6810032
Vieja	344	39	12·43	164	46	27·83	4·9327801
Newman	285	10	16·73	105	36	09·93	4·9172799

EAGLE.

On highest peak in Eagle Mountains, sometimes called Livermore Peak, in El Paso Co., Tex., about 25 miles southeast from Sierra Blanca.

Permanent mark: Conical pile of rocks.

[Latitude, 30° 55′ 14″·41. Longitude, 105° 05′ 08″·13.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sierra Blanca	137	44	08·48	317	33	17·14	4·6957501
Diablo	207	58	33·38	28	03	51·05	4·5409601
Newman	264	32	41·07	85	03	44·82	4·9847437
Chispa	289	59	46·68	110	11	20·22	4·5826108
Baldy	289	42	54·77	110	10	54·16	4·9677230
Vieja	322	59	54·09	143	12	21·96	4·8126761
Salt	175	22	31·67	355	20	35·69	4·8640142

CHISPA.

On highest point in mountains, about 4 miles north from Chispa, a station on the Galveston, Harrisburg and San Antonio Railroad, in Jeff Davis Co., Tex.

Permanent mark: Conical pile of rocks.

[Latitude, 30° 48′ 07″·73. Longitude, 104° 42′ 36″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Eagle	110	11	20·22	289	59	46·68	4·5826108
Diablo	156	01	31·35	335	55	12·13	4·6810032
Sierra Blanca	125	53	26·69	305	30	59·89	4·9312553
Newman	249	53	33·71	70	12	59·89	4·8072184
Baldy	289	42	39·43	109	59	05·23	4·7371129
Vieja	355	32	32·57	175	33	30·34	4·5902892

NEWMAN.

On high point near northwest extremity of Davis Mountains, in Jeff Davis Co., Tex., about 3 or 4 miles northeast from Mr. Newman's ranch and about three-fourths of a mile north from Antelope Spring.

Permanent mark: Conical pile of rocks with tree in center.

[Latitude, 30° 59′ 58″·36. Longitude, 104° 04′ 45″·31.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Diablo	105	36	09·93	285	10	16·73	4·9172799
Eagle	85	03	44·82	264	32	41·07	4·9847437
Chispa	70	12	59·89	249	53	33·71	4·8072184
Vieja	43	33	10·13	223	14	47·84	4·9218841
Baldy	12	39	43·39	192	36	48·71	4·6172386
Star	312	08	25·43	132	17	11·67	4·5653822

STAR.

A high detached mountain near northeast corner of Davis Mountains, in Jeff Davis Co., Tex. Mountain is in pasture known as Star Ranch, about 15 miles north from Fort Davis, and about 1 mile west from Lympia Creek, at point on road from Fort Davis to Victoria, 15 miles from former.

Permanent mark: Stone marked $\frac{\text{U. S.}}{\text{G.} | \text{S.}}$

[Latitude, 30° 46′ 36″·32. Longitude, 103° 47′ 40″·23.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Newman	132	17	11·67	312	08	25·43	4·5653822
Baldy	66	42	40·09	246	31	02·55	4·5977449
Chinati	35	53	56·59	215	33	12·62	5·0513069
Mount Ord	335	42	44·44	155	51	14·20	4·8147622

BALDY.

The highest point of Davis Mountains, a little south of center of range, in Jeff Davis, Co., Tex.; sometimes called Livermore Peak; about 25 miles northwest from Marfa, and about 20 miles a little north of east from Valentine.

Permanent mark: Conical pile of rocks.

[Latitude, 30° 38′ 05″·85. Longitude, 104° 10′ 26″·27.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Newman	192	36	48·71	12	39	43·39	4·6172386
Chispa	109	59	05·23	289	42	39·43	4·7371129
Eagle	110	10	54·16	289	42	54·77	4·9677230
Vieja	67	24	10·97	247	08	47·88	4·7200918
Chinati	21	13	17·03	201	04	04·78	4·9090391
San Jacinto	347	47	01·94	167	53	37·83	4·9998026
Santiago	320	23	31·31	140	46	24·49	5·0600854
Mount Ord	304	32	39·98	124	52	40·70	4·8861505
Star	246	31	02·55	66	42	40·09	4·5977449

VIEJA.

he highest point of Vieja range of mountains, in Presidio Co., Tex., t 15 miles southwest from Valentine and about 3 or 4 miles from Grande River.

[Latitude, 30° 27′ 07″·33. Longitude, 104° 40′ 42″·70.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Eagle	143	12	21·96	322	50	54·09	4·8126761
Diablo	164	46	27·83	344	39	12·43	4·9327801
Chispa	175	33	30·34	355	32	32·57	4·5902892
Newman	223	14	47·84	43	33	10·13	4·9218841
Baldy	247	08	47·88	67	24	10·97	4·7200918
Mount Ord	281	35	28·89	102	10	44·07	5·0579310
Chinati	340	43	44·31	160	49	47·34	4·7681425

MARFA.

ıpola Court-House, county seat of Presidio Co., Tex.

[Latitude, 30° 18′ 46″·12. Longitude, 104° 01′ 20″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chinati	47	50	25·38	227	36	41·60	4·7734994
Baldy	157	50	42·21	337	46	05·21	4·5862461

MOUNT ORD.

n highest point on Mount Ord, in Brewster Co., Tex., a large ntain about 12 miles a little south of east from Alpine, a station on Galveston, Harrisburg and San Antonio Railroad.

rmanent mark: Conical pile of rocks.

[Latitude, 30° 14′ 23″·04. Longitude, 103° 30′ 56″·05.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Baldy	124	52	40·70	304	32	39·98	4·8861505
Vieja	102	10	44·07	281	35	28·89	5·0579310
Chinati	71	18	22·53	250	49	25·00	4·9916155
San Jacinto	38	19	17·11	218	06	05·66	4·8362994
Santiago	347	57	28·02	168	00	26·62	4·6619233
Star	155	51	14·20	335	42	44·44	4·8147622
Chisos	349	30	09·00	169	36	24·00	5·0495105

CHINATI.

highest point in the Chinati Mountains, in Presidio Co., Tex., t 45 miles southwest from Marfa, and at the head of Cibolo Creek, t 18 miles west from Shafter silver mines and about 4 miles from Poole's ranch.

Permanent mark: Conical pile of rocks.

[Latitude, 29° 57′ 09″·32. Longitude, 104° 28′ 41″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Vieja	160	49	47·34	340	43	44·31	4·7681425
Baldy	201	04	04·78	21	13	17·03	4·9090391
Star	215	33	12·62	35	53	56·59	5·0513072
Mount Ord	250	49	25·00	71	18	22·53	4·9916155
Santiago	277	00	07·31	97	31	52·08	5·0144016
San Jacinto	293	28	08·54	113	43	45·32	4·7413449
Marfa	227	36	41·60	47	50	25·38	4·7734994
Chisos	304	19	09·00	124	53	55·00	5·1399097

SAN JACINTO.

On highest point of San Jacinto Mountain, in Presidio Co., Tex., about 6 miles a little east of south from Alamita, an abandoned post-office, about 50 miles south from Marfa, very near the line between Presidio and Brewster counties.

Permanent mark: Conical pile of rocks.

[Latitude, 29° 45′ 12″·59. Longitude, 103° 57′ 19″·11.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chinati	113	43	45·32	293	28	08·54	4·7413449
Baldy	167	53	37·83	347	47	01·94	4·9998026
Mount Ord	218	06	05·66	38	19	17·11	4·8362994
Santiago	260	04	22·01	80	20	25·89	4·7232080

SANTIAGO.

On highest part of Santiago Mountain, in Brewster Co., Tex., a well known mountain about 18 miles a little north of east from Mr. Collinson's ranch.

Permanent mark: Conical pile of rocks.

[Latitude, 29° 50′ 04″·66. Longitude, 103° 24′ 59″·26]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Ord	168	00	26·62	347	57	28·02	4·6619233
Baldy	140	46	24·49	320	23	31·31	5·0600854
Chinati	97	31	52·08	277	00	07·31	5·0144016
San Jacinto	80	20	25·89	260	04	22·01	4·7232080

CHISOS.

In southern portion of Foley Co., Tex., near Rio Grande. Highest point in Chisos Mountains. Not occupied.

[Latitude, 29° 14′ 43″·36. Longitude, 103° 18′ 19″·90.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Ord	169	36	24·00	349	30	09·00	5·0495105
Chinati	124	53	55·00	304	19	09·00	5·1399097

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SOUTH DAKOTA.

METHODS OF WORK.

The area actually covered by the work in the Black Hills is about 2,500 square miles, extending from the Nebraska state line, latitude 43° 00′, to latitude 44° 30′.

The work was commenced in 1891 by Mr. C. H. Fitch, who selected a site for a base line of which he made a preliminary measurement. The line is in the valley of Box Elder Creek about 4 miles northeast of Rapid City. Mr. W. S. Post, in the same year, built signals at a few stations of the expansion, but was prevented by bad weather from measuring the final angles.

In the fall of 1893 Mr. E. M. Douglas remeasured the base line and located eighteen stations in its development and in the main system of triangulation, including the connection with the astronomical pier at Rapid City. The base line was measured three times with a 300-foot steel tape; temperature was taken at each tape length; the line was supported at each 50 feet and was under a uniform tension of 20 pounds. The adopted length of the line after making corrections for slope, temperature, reduction to sea level, etc., is 25,796·115 feet (nearly 5 miles), and the probable error of the three measurements is 0·84 inch.

The initial astronomical point on which the triangulation depends is a pier in the county court-house yard in Rapid City, the position of which was determined by Mr. S. S. Gannett, in 1890, by latitudes from zenith distances and longitudes from telegraphic exchange of time with St. Louis observatory. Mr. Gannett at the same time fixed a point on the meridian about 1 mile north. From this meridian the azimuths were computed.

Observations were taken by single and combined directions and the whole scheme of triangulation was divided into blocks of about 5 stations each and adjusted by least squares. The stations and signals consisted of low tripods of lumber with a signal pole in the center, under which the instrument was placed.

DESCRIPTIONS AND POSITIONS OF STATIONS.

BEAR BUTTE.

Very prominent butte about 5 miles northeast of Sturgis, in Meade Co., S. Dak., known to every one within 25 miles.

Permanent mark:

U. S.
+
G. S.

cut on large bowlder. Stone projects about 6 inches above surf ground.

[Latitude, 44° 28′ 34″·4. Longitude, 103° 25′ 08″·9.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Custer	43 52 42	223 39 44	4·5515290
Costello	306 08 11	126 21 58	4·5111050

CUSTER PEAK.

Local name for highest peak in Lawrence Co., S. Dak., ab miles southwest of Brownsville station, on narrow-gauge railroad Piedmont to Lead.

Permanent mark: Rock monument about 6 feet high and 5 f diameter at the base; 5-inch pine pole in the center.

[Latitude, 44° 14′ 41″·4. Longitude, 103° 43′ 41″·1.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Mitchell	279 53 51	100 19 54	4·7036670
Bear Butte	223 39 44	43 52 42	4·5515290

PIEDMONT.

Lone peak, about 2 miles east of Piedmont station, Fremont, Ell and Missouri Valley Railroad, in Meade Co., S. Dak. Local na Miller's butte.

Permanent mark:

U. S.
+
G. S.

cut on large rock, which projects about 5 inches above the groun

[Latitude, 44° 13′ 55″·8. Longitude, 103° 21′ 40″·5.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Costello	249 43 58	69 55 18	4·3618527
Mitchell	289 59 27	110 10 08	4·3376719
Sammis	333 43 06	153 48 16	4·3487698

COSTELLO.

On high knoll on summit of ridge north of Elk Creek, in Meade S. Dak., in the SE. ¼ of sec. 13, T. 4 N., R. 8 E. The hill break rapidly about 50 yards east and west and 100 yards north, the st being on a spur from the main ridge or divide.

Permanent mark is on a large stone projecting about 4 inches above surface of ground, marked

U. S.
+
G. S.

[Latitude, 44° 18′ 12″·9. Longitude, 103° 05′ 26″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bear Butte........	126	21	58	306	08	11	4·5111050
Piedmont..........	69	55	18	249	43	58	4·3618527

MITCHELL.

On summit of ridge next north of Box Elder Creek, in Meade Co., S. Dak., in sec. 2, R. 8 E., T. 2 N. Section line is about 440 feet east. There is small board cabin 515 feet northeast.

Station marked by large stone, which projects 10 inches above surface of ground. Stone marked

U. S. G. S.
+

[Latitude, 44° 09′ 53″·8. Longitude, 103° 06′ 20″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Piedmont..........	110	10	08	289	59	27	4·3376719
Sammis............	40	12	33	220	07	01	4·2155180
Dunning..........	336	08	42	156	10	38	3·9652013
Custer Peak.......	100	19	54	279	53	51	4·7036670

WEST BASE.

At west end of base line as marked out in 1893, in Pennington Co., S. Dak. In flat in SE. ¼ of NW. ¼ of sec. 20, R. 8 E., T. 2 N. The quarter corner post (center of sec. 20) is 75·5 feet distant, east of south. Station center marked on a large bowlder projecting about 4 inches above ground and marked

U. S. G. S.
+
W. B.

the + being the center of the station. Reference points, 25 feet distant, are placed on the base line east of station, and two at 90 degrees from it, each marked R $\underset{\vee}{+}$ P, the arrow pointing toward the station and the + being 25 feet distant from it. The one on the base line is about 6 inches east of the fence line.

[Latitude, 44° 07′ 09″·2. Longitude, 103° 10′ 29″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dunning...........	289	53	54	109	58	44	3·9938653
East Base..........	271	06	43	91	11	49	3·8955654

WHITE.

On highest of the foothills, 2½ miles northwest of the court-
Rapid City, Pennington Co., S. Dak. Station is on eastern sl
hill, about 50 yards north of the highest point.

Permanent mark is U. S. + cut in bed rock (limestone) lev
surface of ground. White's ranch is about three-fourths of
east. An old wood road from Rapid City goes nearly to the s
This station was used in connecting latitude and longitude sta
court-house yard with the main scheme of triangulation.

[Latitude, 44° 06′ 53″·7. Longitude, 103° 14′ 12″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sammis	000	49	04	180	49	01	3·8447879
Dunning	281	23	54	101	31	19	4·1618680

ASTRONOMICAL PIER.

A brick pier in court-house yard, Rapid City, in Penningto
S. Dak., about 75 feet west of the southwest corner of the court-
The pier extends about 3 feet below surface of ground and ab
inches above; it has a dressed sandstone cap marked U. S. G. S
position of this point was determined astronomically by S. S. G
in 1890.

[Latitude, 44° 04′ 45″·24. Longitude, 103° 12′ 59″·28.]

To station.	Azimuth			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Meridian Mark	180	00	00	00	00	00	3·3108

SAMMIS.

About 2 miles southwest of Rapid City, on the first knoll at t
of the hill, about 50 yards west of the Rapid City and Rockervil
and telephone line, in Pennington Co., S. Dak. The road reach
summit of the hill about 100 yards south.

Station marked by a large stone projecting about 10 inches
the ground, marked

U. S.
+
G. S.

[Latitude, 44° 03′ 07″·1. Longitude, 103° 14′ 16″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dunning	253	56	21	74	03	49	4·1735420
Mitchell	220	07	01	40	12	33	4·2155180
Piedmont	153	48	16	333	43	06	4·3487698
Harney Peak	48	13	32	228	01	37	4·4894670
White	180	49	01	0	49	04	3·8447879

EAST BASE.

a spur from the main ridge, on the north side of Box Elder Creek mington Co., S. Dak. In the NE. ¼ of SW. ¼ of sec. 19, T. 2 N., . The station center is a + on a large rock projecting about es above surface of ground and marked

U. S. G. S.
+
E. B.

nce stones 25 feet distant, one on the line toward West Base and right angles to the line are marked R $\underset{\vee}{+}$ P, the arrow pointing l the station and the + being 25 feet distant therefrom.

[Latitude, 44° 07′ 04″·0. Longitude, 103° 04′ 35″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dunning..........	336	17	40	156	18	24	3·5437858
West Base........	91	11	49	271	06	43	3·8955654

DUNNING.

ummit of divide between Box Elder and Rapid creeks, in Pen- n Co., S. Dak. In sec. 8, T. 1 N., R. 10 E.

nanent mark: Large round-topped bowlder projecting above e of ground about 8 inches and marked

U. S.
+
G. S.

[Latitude, 44° 05′ 20″·3. Longitude, 103° 03′ 32″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thompson Butte.....	341	08	15	161	11	36	4·3010173
Mitchell...............	156	10	38	336	08	42	3·9652013
East Base.............	156	18	24	336	17	40	3·5437858
Sammis................	74	03	49	253	56	21	4·1735420
West Base............	109	58	44	289	53	54	3·9938653
White..................	101	31	19	281	23	54	4·1618680

HARNEY PEAK.

l-known local name for the highest peak of Black Hills, in Pen- n Co., S. Dak. There are two summits, the station is on the rn one, and about the center of the highest part as seen from

nanent mark: A three-fourths inch iron bolt leaded into a hole into the rock. Bolt is on the west slope of rock and its top

is about level with the rock 3 inches east. This mark is ce
station.

[Latitude, 43° 51′ 59″·6. Longitude, 103° 31′ 27″·3.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gap	342	04	07	162	10	37	4·6142306
Cheyenne	311	48	16	132	05	21	4·6497967
Bradley	8	44	20	188	40	25	4·7015755
Sammis	228	01	37	48	13	32	4·4894670
Thompson Butte	262	17	52	82	40	35	4·6457526

THOMPSON BUTTE.

A prominent and well-known conical-shaped peak, in Pen
Co., S. Dak., about 15 miles southeast of Rapid City and about
south of Rapid Creek. The station center is about 5 feet south
highest point. Stone 10 inches square projecting 3 inches ab
ground is marked

U. S.
+
G. S.

[Latitude, 43° 55′ 07″·0. Longitude, 102° 58′ 42″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Harney Peak	82	40	35	262	17	52	4·6457562
Cheyenne	16	51	03	196	45	31	4·5707447
Dunning	161	11	36	341	08	15	4·3010173

CHEYENNE.

At highest point of divide, 13 miles northeast of Buffalo
Custer Co., S. Dak., about 4 miles south of Smith's ranch on
Creek.

Permanent mark:

U. S.
+
G. S.

cut on a bowlder that projects about 3 inches above the ground.
has been an old rock pile about 6 feet south.

[Latitude, 43° 35′ 52″·6. Longitude, 103° 06′ 43″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gap	65	49	36	245	39	02	4·3550398
Windy	8	21	55	188	18	58	4·6004321
Harney Peak	132	05	21	311	48	16	4·6497967
Thompson Butte	196	45	31	16	51	03	4·5707447

GAP.

On the highest point of the ridge, about 3 miles northwest of
Gap town, near the edge of the bluff, in Custer Co., S. Dak.

ile about 6 feet northeast. Center of station marked by one-half rass bolt in bed rock, set with plaster of paris. Projects up rock one-half inch. U. S. G. S. cut on same rock. Bolt is 11½ south of center of last S.

[Latitude, 43° 30′ 51″·0. Longitude, 103° 22′ 03″·4.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Bradley	62 35 32	242 25 10	4·3597806
Fossil	17 26 46	197 21 19	4·5548890
Windy	333 34 51	153 42 26	4·5265574
Cheyenne	245 39 02	65 49 36	4·3550398
Harney Peak	162 10 37	342 04 07	4·6142306

BRADLEY.

projecting point of the ridge, on south side of Minnekahta Creek, 3 miles west of Hot Springs, in Fall River Co., S. Dak. The is on nearly the highest part of the ridge. The ridge slopes toward the south, and is called Bradley's Flat. Jones's sheep is about 3 miles north.

aanent mark:

U. S.
+
G. S.

the bed rock (soft sandstone), about 2 inches below the surthe ground. There are two large stones piled on each tripod leg. furthest northeast has one large piece of petrified log on it, and s cut on the side. There is a hay road from the valley to the the flat, running up the side of the hill one-fourth of a mile east station.

[Latitude, 43° 25′ 08″·5. Longitude, 103° 37′ 07″·0.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Gap	242 25 10	62 35 32	4·3597806
Harney Peak	188 40 25	8 44 20	4·7015755

FOSSIL.

nob at the head of Tepee Creek, Fall River Co., S. Dak., at the between Tepee and Dry creeks; about 14 miles north of west elrichs.

nanent mark: +U. S. G. S. cut on the cap rock (brittle lime-; the + is 6 inches northwest of the center of the U.

[Latitude, 43° 12′ 21″·52. Longitude, 103° 30′ 00″·0.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
State Line	320 08 41	140 18 13	4·4711761
Gap	197 21 19	17 26 46	4·5548890

WINDY.

A butte about 5 miles southeast of Smithwick, in Fall Ri
S. Dak., 5 miles northeast of Oelrichs, and 3 miles south of
Ranch.

Station marked on a piece of limestone about 6 inches thi
inches by 15 inches, buried flush with the ground. Stone is
U. S. + G. S.

[Latitude, 43° 14′ 35″·0. Longitude, 103° 11′ 00″·5.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
State Line	14 18 00	194 14 33	4·4427422
Cheyenne	188 18 58	8 21 55	4·6004321
Gap	153 42 26	333 34 51	4·5265574

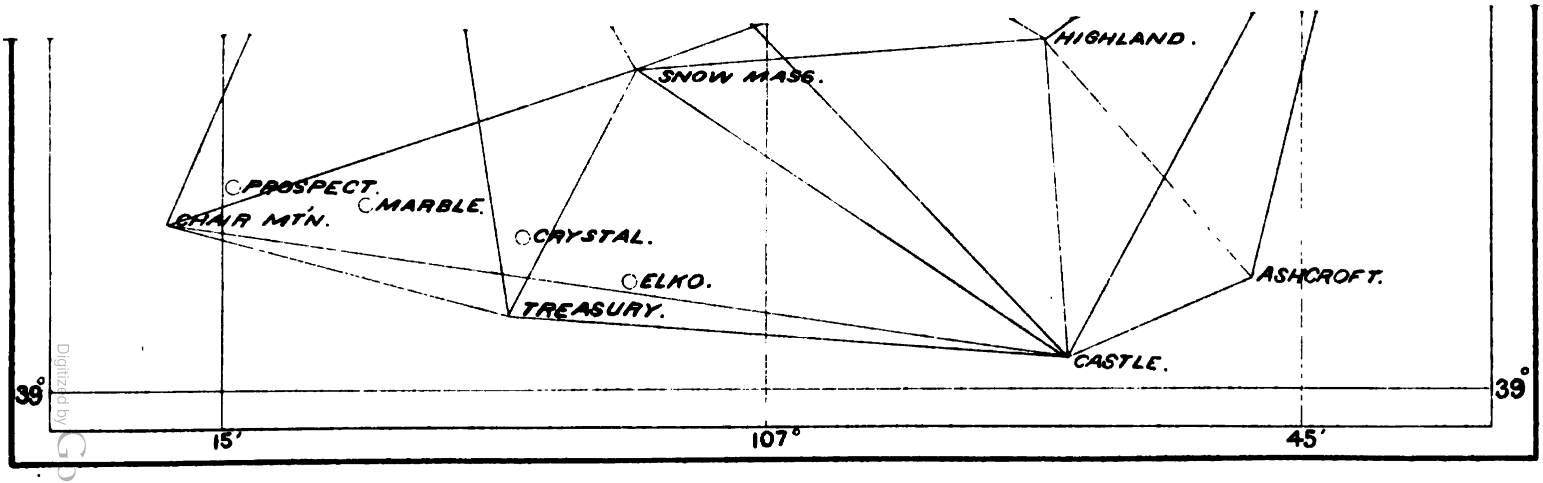
STATE LINE.

About 1½ miles west of the Fremont, Elkhorn and Missour
Railroad track, in Dawes Co., Nebr. On the highest part of
186.2 feet from the 184½ milepost of the Nebraska-South Dako
line, as located in 1892–'93 and marked by large stone posts s
half mile. The station is due south of the State line 89½ feet.

Center point of station is a nail in a 2 by 4 stake which projec
ground about 6 inches.

[Latitude, 43° 00′ 04″·5. Longitude, 103° 16′ 02″·7.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Windy	194 14 33	14 18 00	4·4427422
Fossil	140 18 13	320 08 41	4·4711761



TRIANGULATION OF ASPEN, COLORADO.

SCALE.

ASPEN, COLO.

METHODS OF WORK.

This work was commenced in 1891 by Morris Bien, who measured a base line 1 mile in length along one of the streets of Aspen. This line was expanded and a number of stations located for immediate use in making a large scale map of the mining district. In 1893 the triangulation was extended over an area of about 400 square miles by E. M. Douglas.

An attempt was made to compute a base line for the work from two unclosed triangles of the Hayden survey, but as the two values for the line thus computed differed materially they were both rejected and the line between Bien's station 12 and 47 as computed by him was adopted for a base. It so happened that this distance is nearly the mean of the two determinations from the Hayden angles. The initial latitude and longitude for the work are from the U. S. C. & G. S. position of Treasury Mountain, a station in the transcontinental scheme. The azimuth is from the U. S. C. & G. S. determination at the same point. The positions thus derived differ from the Hayden location about 9 seconds in latitude and 18 seconds in longitude. Angles were measured by the method of repetition in sets of five, using an 8-inch vernier theodolite reading to 10 seconds. The stations and figures were arbitrarily adjusted, the limited extent of the work not justifying the adjustment by least squares.

DESCRIPTIONS AND POSITIONS OF STATIONS.

SOPRIS.

A well-known peak, about 20 miles west of Aspen, in Pitkin Co., Colo. Station is on the southeast summit.

Permanent mark: A large rock pile, same place as the Hayden Station. A good trail leads from an old sawmill to top of divide, 1 mile south of the peak.

[Latitude, 39° 15′ 36″·2. Longitude, 107° 09′ 57″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Highland	300	25	43	120	36	38	4·460953
Snow Mass	331	43	59	151	47	43	4·254617
Treasury	348	16	24	168	18	53	4·447570
Chair Mountain	24	15	54	204	11	27	4·393718
Bien's Station (47)	276	26	47	96	43	06	4·572241
Bien's Station (12)	296	58	48	117	09	54	4·453768
Castle Peak	316	41	18	136	52	48	4·583794

BIEN'S STATION (47).

A small blazed pine tree on a grassy slope, on east or north side of Hunter Creek, in Pitkin Co., Colo., about 5 miles from Aspen. There is an abandoned sawmill about 1 mile west.

[Latitude, 39° 13′ 17″·4. Longitude, 106° 44′ 10″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bien's Station (12)	53	47	46	233	42	35	4·165618
Sopris	96	43	06	276	26	47	4·572241
Ashcroft	10	25	08	190	23	32	4·308365

BIEN'S STATION (12).

On ridge, about 1 mile north of Highland, in Pitkin Co., Colo.

Permanent mark: A small pine tree, blazed and marked U. S. G. S.

[Latitude, 39° 08′ 36″·7. Longitude, 106° 52′ 22″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sopris	117	09	54·7	296	58	48	4·453768
Bien's Station (47)	233	42	35·5	53	47	46·3	4·165618

HIGHLAND.

The highest point of the ridge on west side of Castle Creek, at the mouth of Conundrum (or West Castle) Creek and opposite the settlement of Highland, in Pitkin Co., Colo.

Permanent mark: Large rock monument.

[Latitude, 39° 07′ 40″·2. Longitude, 106° 52′ 39″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sopris	120	36	38	300	25	43	4·460953
Snow Mass	86	01	54	265	54	43	4·216278
Ashcroft	318	14	44	138	18	28	4·109715

SNOW MASS.

A well-known peak, about 11 miles southwest of Aspen, in Pitkin Co., Colo., about 3 miles east of Crystal post-office and about same distance south of Capitol Peak. Hayden triangulation point.

Permanent mark: A large upright rock on highest part of peak.

[Latitude, 39° 07′ 02″·7. Longitude, 107° 04′ 03″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sopris	151	47	43	331	43	59	4·254617
Highland	265	54	43	86	01	54	4·216278
Treasury	13	41	26	193	40	12	4·077312

ASHCROFT.

the summit of the ridge southeast of Ashcroft town, in Pitkin olo. Large stone monument with central pole marks the station.

[Latitude, 39° 02′ 28″·6. Longitude, 106° 46′ 43″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Highland	138	18	28	318	14	44	4·109715
Bien's Station (47).	190	23	32	10	25	08	4·308365

CASTLE PEAK.

ell-known peak, about 12 miles south of Aspen, in Pitkin Co., highest peak within 25 miles. Round top summit about 100 by in extent.

nanent mark: Large rock monument with pole in center.

[Latitude, 39° 00′ 29″·8. Longitude, 106° 51′ 44″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sopris	136	52	48	316	41	18	4·583794

TREASURY.

und topped peak, about 3 miles south of Crystal Post-Office, in son Co., Colo., U. S. C. & G. S. Station (primary point for trans- ental triangulation). A mining trail which starts at Elko runs e summit and within 50 feet of the station.

[Latitude, 39° 00′ 46″·2. Longitude, 107° 06′ 00″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sopris	168	18	53	348	16	24·0	4·447570
Snow Mass........	193	40	12	13	41	26·0	4·077312
Chair Mountain ..	107	06	26	286	59	30·5	4·220116

CHAIR MOUNTAIN.

l-known point on west side of Rock Creek about 3 miles south- f Prospect, in Gunnison Co., Colo. Large rock monument on t point.

[Latitude, 39° 03′ 24″·0. Longitude, 107° 17′ 00″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Treasury	286	59	30·5	107	06	26	4·220116
Sopris	204	11	27·5	24	15	54	4·393718

WYOMING.

METHODS OF WORK.

The scheme of triangulation at Laramie, Wyo., depends u astronomical station at Laramie determined in 1872 by the U. graphical Surveys west of the one hundredth meridian. The ment used was a Wurdemann zenith telescope, J. H. Clark be observer. Telegraphic communication for longitude was mad Salt Lake City, Utah. During September, 1892, Mr. Frank T of the U. S. Geological Survey, made a small development from base measured along the ties of the Union Pacific Railroad jus of the town of Laramie. Two measurements were made with foot steel tape during a cloudy day, giving the following result

First measurement corrected for temperature and inclination	13
Second measurement corrected for temperature and inclination.........	13
Difference	
Mean base reduced to sea level..	13

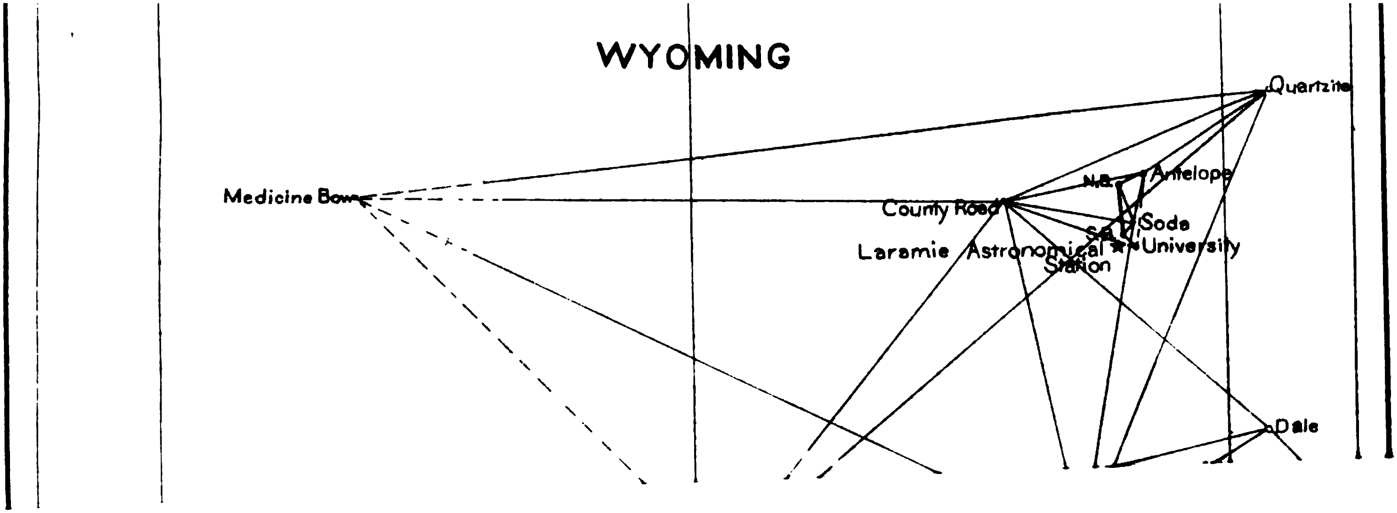
This base was selected and measured hurriedly in order to g topographic parties immediate control for their work, it being the tion to remeasure it later in the season or to select a new base would afford a better development, but this plan was not carri The ends of the base were not marked permanently but were ferred to two points, Soda and Antelope. The astronomical was connected with Soda through University and not with th porary base.

Since the astronomical station was established the city of L has grown up around it, and it is now surrounded by trees and ings. The dome of the State University was connected with t tion by a series of measurements along the streets of the town solar transit and a 300-foot steel tape. The instrument used triangulation was an 8-inch Fauth micrometer microscope the Tripod signals were built on all stations occupied in advance angle work. No least square adjustment has been applied to th gulation.

DESCRIPTIONS AND POSITIONS OF STATIONS.

SODA.

On south edge of Red Mesa, one-half a mile north of Lara Albany Co., Wyo., and two-thirds of a mile east of Soda Mill.


WYOMING
Quartzite
Antelope
N.B.
Medicine Bow
County Road
Sode
S.B.
Laramie
Astronomical Station
University
Dale

ark: A piece of 3-inch iron pipe 4 feet long set 3 feet in
h cross cut on top.

[Latitude, 41° 20′ 10″·28. Longitude, 105° 35′ 02″·97.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
ntelope	194	03	50	14	04	17	3·5808681
unty road	90	11	38	279	06	52	4·0089511
uartzite	226	32	15	46	37	16	4·1634587
niversity	355	13	33	175	13	39	3·4108516

UNIVERSITY.

State University at Laramie, in Albany Co., Wyo.

[Latitude 41° 18′ 47″·09. Longitude, 105° 34′ 53″·75.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
da	175	13	39	355	13	33	3·4108516

ASTRONOMICAL PIER.

Laramie, in Albany Co., Wyo., between Union Pacific
econd street and North A street and University avenue.
t end of house lot No. 8 (Hayward). The wooden pier
ved, but a small depression in the ground is pointed
ginal position of the observing block. Determined by
raphical Surveys west of the one hundredth meridian,

[Latitude, 41° 18′ 51″·80. Longitude, 105° 35′ 33″·60.]

ANTELOPE.

y butte 2½ miles northeast of Soda Mill, at Laramie, in
yo.

ark: A piece of 3-inch iron pipe 4 feet long set 3 feet in
h cross cut on top.

[Latitude, 41° 22′ 10″·06. Longitude, 105° 34′ 23″·14.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
oda	14	04	17	194	03	50	3·5808681
ounty Road	79	22	51	259	17	38	4·0490181
uartzite	236	45	17	56	49	51	4·0621799

COUNTY ROAD.

art of grassy prairie, in Albany Co., Wyo., 8 miles north-
e, on county road. A bluff on north descends to a lake

Permanent mark: A large stone set 2 feet in the ground wit on lead bolt in center.

[Latitude, 41° 21′ 02″·92. Longitude, 105° 42′ 16″·45.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lindsey	348	18	12	168	20	52	4·4455596
Dale	312	32	22	132	42	00	4·4429087
Antelope	259	17	38	79	22	51	4·0490181
Soda	279	06	52	99	11	38	4·0089511

QUARTZITE.

On high ridge, 10 miles northeast of Laramie, in Albany Co. about 1½ miles south of main wagon-road crossing.

[Latitude, 41° 25′ 34″·91. Longitude, 105° 27′ 27″·53.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Soda	46	37	16	226	32	15	4·1634587
Lindsey	22	54	35	202	47	29	4·5882876
Medicine Bow	84	29	56	263	55	55	4·8577944
Antelope	56	49	51	236	45	17	4·0621799

DALE.

On timbered ridge 10 miles southeast of Laramie, Albany Co A cross-country road from Laramie to Sherman runs along the the ridge about one-eighth of a mile east of station.

[Latitude, 41° 10′ 54″·33. Longitude, 105° 27′ 39″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
County Road	132	42	00	312	32	22	4·4429087
Ames	315	15	29	135	18	04	3·8923764
Lindsey	60	02	23	239	55	26	4·2325042

AMES.

The Ames monument on the Union Pacific Railroad, at Sher Albany Co., Wyo. Not occupied.

[Latitude, 41° 07′ 54″·55. Longitude, 105° 23′ 44″·32.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lindsey	81	40	17	261	30	45	4·3119835
Dale	135	18	04	315	15	29	3·8923764

LINDSEY.

On butt of long, bare ridge, running north from high-timbered mesa, 20 miles south of Laramie, in Albany Co., Wyo. One mile north of station are two springs, at a deserted sheep ranch on edge of dry lake.

[Latitude, 41° 06′ 17″·33. Longitude, 105° 38′ 14″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
County Road	168	20	52	348	18	12	4·4455596
Dale	239	55	26	60	02	23	4·2325042
Ames	261	30	45	81	40	17	4·3119835
Medicine Bow	116	48	46	296	21	58	4·8031279
Jelm	88	32	10	268	18	51	4·4526265
Quartzite	202	47	29	22	54	35	4·5882876

JELM.

Timbered peak, known as Jelm Mountain, in Albany Co., Wyo., 25 miles southwest of Laramie, and 2 miles southeast of Woods Post-Office, on the Big Laramie River. Elevation, 9,676 feet.

Has not been occupied.

[Latitude, 41° 05′ 52″·06. Longitude, 105° 58′ 28″·70.]

To station.	Azimuth.			Back azimuth.			Log. dist,
	°	′	″	°	′	″	*Meters.*
Lindsey	268	18	51	88	32	10	4·4526265

MEDICINE BOW.

Known as Medicine Bow Peak, the highest point of the Medicine Bow Range, at heads of Little Laramie River and Medicine Bow Creek, about 38 miles west of Laramie, in Albany Co., Wyo. Elevation, 12,085 feet. Location, approximate.

Signal: None. Has not been occupied.

[Latitude, 41° 21′ 39″·4. Longitude, 106° 18′ 54″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Quartzite	263	55	55	84	29	56	4·8577944
Lindsey	296	21	58	116	48	46	4·8031279

MONTANA.

METHODS OF WORK.

The Montana triangulation covers an area of about 50,00
miles and is dependent upon a base and astronomical statio
near Bozeman, Mont. The astronomical station was establishe
by the U. S. geographical surveys west of the one hundredth
The observer at Bozeman was Mr. J. H. Clark and the in
employed was a Wurdemann zenith telescope of 28 inches foc
The telegraphic connection with the observatory at Ogden, U
made via Helena, Mont., Dr. F. Kampf being the observer a
During October, 1877, Lieut. Tillman, of the U. S. Geographica
west of the one hundredth meridian, selected the present
base, which is located just west of the town of Bozeman, and me
with a steel tape. He also connected it with the astronomica
and determined the azimuth, but carried on no expansion.

In 1883 Mr. J. H. Renshawe, of the U. S. Geological Survey,
by Mr. H. S. Chase, remeasured the base with a secondary ba
ratus. The whole line was measured once and also computed
gulation from a second measurement of the middle third wit
lowing result:

Length of base by first measurement....................................
Length of base by triangulation from middle third................ .....
Weighted mean..
Length of base reduced to sea level......................................

Mr. J. H. Renshawe, during 1882, and his assistant, Mr. H.
in 1883–'84, connected the base with the astronomical station an
an expansion southward into the Yellowstone National Pa
instrument used in this triangulation was a 10-inch vernier t
reading to 10 seconds. The method of observing angles was
that of circle readings and repeated angles, establishing cond
station adjustment.

In 1886 Mr. E. M. Douglas was placed in charge of the trian
in Montana, and during the field season of 1886–'87–'88 reoccup
of the stations of 1882–'84 and extended the triangulation thro
tral Montana. Assisted by Mr. C. F. Urquhart, he readjusted
squares the work of Mr. H. S. Chase, including many new poi
remainder of the triangulation in central Montana has been c

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from arbitrary adjustments, as the character of the work did not warrant a more rigid adjustment, the weather conditions having been very unfavorable for the performance of close work.

The instrument employed was an 8-inch vernier theodolite reading to 10 seconds. Natural points were generally sighted in advance of occupation. The method of reading angles was that of the earlier work of Messrs. Renshawe and Chase. A number of distant outlying points on the north and west have been sighted to, but not occupied.

During 1889 Mr. Frank Tweedy carried a short system of triangulation down the Yellowstone River from Bridger-Crazy as a base and in 1889 extended this work eastward to Fort Custer and southward to the Wyoming line, having reoccupied all his stations of 1889. In this work the instrument used was an 8-inch Fauth micrometer microscope theodolite. In all this work either stone cairns on the higher points or simple wooden tripods 10 to 20 feet high on the lower points were erected in advance of the instrumental work for signals.

At Fort Custer a check base about 5 miles long was selected and marked, but not measured. The stations connecting it with the triangulation were occupied, but the base figure has not been adjusted. Mr. W. S. Post, in 1891, extended a narrow belt of triangles from the stations Red Bluff-Little Horn near the Wyoming line eastward across northern Wyoming to a base at Rapid City, S. Dak., but stormy weather prevented his occupying his stations with sufficient completeness to form a connection between the Bozeman and Rapid City bases. The triangulation of 1891 has a somewhat weak connection with the Bozeman base through the line Bridger-Crazy.

DESCRIPTIONS AND POSITIONS OF STATIONS.

ASTRONOMICAL PIER.

On the western edge of the town of Bozeman, Gallatin Co., Mont., just north of the main east and west street, and is marked by a section of a tree 2 feet in diameter set in the ground and sawed off at top with nail in center. Determined by the U. S. Geographical Surveys west of the one hundredth meridian in 1873.

[Latitude, 45° 40′ 51″·92 ± 0″·06. Longitude, 111° 02′ 36″·64 ± 0″·53.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
North Base.......	125	12	44.00	305	09	59·78	3·7835255

NORTH BASE.

On slight grassy rise, 4 miles northwest of Bozeman, Gallatin Co., Mont., marked by a stone pier 1 foot square and 4 feet long, set 3 feet in the ground. The portion above ground is square, with letters G. S. cut in on one face and cross cut on top surface.

[Latitude, 45° 42′ 45″·29. Longitude, 111° 06′ 26″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
South Base	334	54	16	154	55	59	3·8663426
Cedar Knoll	53	44	03	233	38	55	4·0628859
Grassy Knoll	281	17	36	101	22	55	3·9929061
Astronomical Pier....	305	10	00	125	12	44	3·7835255

SOUTH BASE.

In field 1 mile southwest of Bozeman, Gallatin Co., Mont., m by stone pier 1 foot square (cross section) and 4 feet long, set in the ground. The portion above ground is squared, with letter G. S. cut in on one face and cross cut on top surface.

[Latitude, 45° 39′ 09″·64. Longitude, 111° 04′ 02″·09.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Point 5...........	163	33	09	343	29	26	4·3742267
Bridger...........	212	44	50	32	50	24	4·2701323
Grassy Knoll.....	234	06	27	54	10	03	3·9065048
Cedar Knoll......	89	11	58	269	05	08	4·0947548
North Base.......	154	55	59	334	54	16	3·8663426

GRASSY KNOLL.

On a grassy knoll 1½ miles north of Fort Ellis and 2½ miles nor of Bozeman, Gallatin Co., Mont., marked by a cairn of stones 3 height.

[Latitude, 45° 41′ 42″·64. Longitude, 110° 59′ 00″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blackmore........	3	17	49	183	16	56	4·4419338
Cedar Knoll......	75	34	25	256	30	23	4·2920765
Point 5	143	41	54	323	34	35	4·3487350
North Base.......	101	22	55	281	17	36	3·9929061
South Base	54	10	03	234	06	27	3·9065048

CEDAR KNOLL.

On knoll 200 feet high, in Gallatin Co., Mont., on west side of tin River, about 2 miles west of Matthew's Hot Springs and just of road from Bozeman to Virginia City.

Permanent mark: Cedar tree trimmed below.

[Latitude, 45° 39′ 03″·61. Longitude, 111° 13′ 36″·46.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gallatin	19	14	57	199	09	00	4·5188944
Point 5	193	57	30	14	00	39	4·3726260
Bridger...........	234	45	20	54	57	45	4·4397549
Blackmore........	322	25	43	142	35	17	4·4566960
North Base.......	233	38	55	53	44	03	4·0628859
Grassy Knoll.....	256	30	23	73	34	25	4·2920765
South Base.......	269	05	08	89	11	58	4·0947548

POINT 5.

On a grassy bench in Gallatin Co., Mont., about 12 miles northwest of Bozeman, Mont., 1 mile north of East Gallatin River and a quarter of a mile northwest of Reese Creek, near Gum's ranch.

Permanent mark: Cairn of stones 3 feet high.

[Latitude, 45° 51′ 24″·87. Longitude, 111° 09′ 12″·76.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bridger	292	41	29	112	50	47	4·2599257
Cedar Knoll	14	00	39	193	57	30	4·3726260
Grassy Knoll	323	34	35	143	14	54	4·3487350
South Base	343	29	26	163	33	09	4·3742267

BRIDGER.

A bare, double peak in Gallatin Co., Mont., 9 miles northeast of Bozeman, Mont., on Bridger Range. The station is on the south point and is marked by a stone cairn 5 feet high. Elevation, 9,100 feet.

[Latitude, 45° 47′ 36″·8. Longitude, 110° 56′ 15″·58.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gallatin	35	32	35	215	14	14	4·7611481
Junction	119	32	27	299	07	50	4·7060882
Boulder	127	06	27	306	24	43	4·9701216
Elk	190	53	58	11	01	56	4·8743200
Crazy	243	35	56	64	04	25	4·7570500
Livingston	300	51	52	121	12	24	4·6383223
Emigrant	342	51	59	163	01	52	4·7884593
Blackmore	7	38	07	187	35	17	4·5899114
South Base	82	50	24	212	44	50	4·2701323
Cedar Knoll	54	57	45	234	45	20	4·4397549
Point 5	112	50	47	292	41	29	4·2599257
Jefferson	76	54	05	256	08	07	4·9331603

JUNCTION.

On high, bare hill in Jefferson Co., Mont., 2 miles west of Missouri River and 7 miles north of Three Forks, Mont., and is marked by small cairn of rocks.

[Latitude, 46° 01′ 03″·34. Longitude, 111° 30′ 31″·21.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Boulder	185	33	01	315	15	55	4·6383496
Bridger	299	07	50	119	32	27	4·7060882
Gallatin	351	09	17	171	15	25	4·8620898
Jefferson	41	02	13	220	40	44	4·7734316

BOULDER.

A bare double peak, in Jefferson Co., Mont., 12 miles northeast of Boulder Valley and 30 miles south of Helena, 2 miles east of Elkhorn mining camp. Elevation, 9,400 feet.

Permanent mark: Stone monument 8 feet high.

[Latitude, 46° 17′ 46″·3. Longitude, 111° 54′ 14″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tweedy	42	43	27	221	57	42	5·087647
Powell	94	40	17	273	53	35	4·919695
Keep Cool	145	22	20	324	45	51	5·047500
Mitchell	159	21	54	339	05	25	4·911482
Ox Bow	190	23	52	10	31	18	4·856460
Neihart	232	29	24	53	26	00	5·095135
Elk	258	18	57	79	08	54	4·955483
Bridger	306	24	43	127	06	27	4·970121
Crazy	283	07	19	104	17	41	5·111892
Junction	315	15	55	135	33	01	4·638349
Jefferson	6	07	27	186	02	57	4·882453

JEFFERSON.

(Local name Hollow Top or Baldy.) High bare limestone Madison Co., Mont., at head of North Fork of North Willow Cree 8 miles southwest of Pony. Elevation, 10,740 feet.

Permanent mark: Stone monument 7 feet high.

[Latitude, 45° 36′ 49″·38. Longitude, 112° 00′ 29″·62.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tweedy	79	18	33	259	37	42	4·881706
Boulder	186	02	57	6	07	27	4·882453
Junction	220	40	44	41	02	13	4·773431
Crazy	250	48	47	72	03	42	5·152230
Elk	225	38	32	46	32	54	5·129725
Bridger	256	08	07	76	54	05	4·933160
Gallatin	298	04	36	118	32	05	4·756180
Hilgard	330	38	22	151	01	47	4·946576
Logan	214	37	19	35	12	49	5·046238

GALLATIN.

A high, bare, sharp granite peak at head of Hell Roaring Cre latin drainage), in Madison Co., Mont., about 26 miles south Bozeman, Mont. Elevation, 10,968 feet.

Permanent mark: Small stone monument 4 feet high.

[Latitude, 45° 22′ 13″·27. Longitude, 111° 21′ 56″·86.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Emigrant	282	31	59	103	00	05	4·7239772
Crazy	229	11	32	49	58	48	5·0470316
Electric	313	58	38	134	21	07	4·7625041
Hilgard	8	21	39	188	17	41	4·7050281
Jefferson	118	32	05	298	04	36	4·7561806
Junction	171	15	25	351	09	17	4·8620898
Point Four	199	09	00	19	14	57	4·5188944
Blackmore	253	12	43	73	28	11	4·4711043
Bridger	215	14	14	35	32	35	4·7611481
Cedar Knoll	199	09	00	19	14	57	4·5188944

BLACKMORE.

A peak about 15 miles south of Bozeman, at head of Cottonwood Creek, in Gallatin Co., Mont. Elevation, 10,196 feet.

Permanent mark: Small stone pile.

[Latitude, 45° 26′ 48″·02. Longitude, 111° 00′ 13″·40.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Gallatin	73	28	11	253	12	43	4·4711043
Cedar Knoll	142	35	17	322	25	43	4·4566060
Grassy Knoll	183	16	56	3	17	49	4·4419338
Bridger	187	35	17	7	38	07	4·5809114
Emigrant	310	51	46	131	04	26	4·4883949
Electric	344	58	02	165	05	07	4·7034796

EMIGRANT.

A high volcanic peak in Park Co., Mont., on east side of Yellowstone River, between Emigrant Gulch and Six Mile Creek, 6 miles southeast of Fridley's Ranch. Elevation, 10,968 feet.

Permanent mark: Stone monument 5 feet high.

[Latitude, 45° 15′ 54″·13. Longitude, 110° 42′ 25″·35.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Electric	19	46	27	199	40	54	4·4829363
Hilgard	57	15	30	236	43	32	4·8488356
Crazy	201	37	56	21	56	57	4·9562002
Granite	278	33	35	99	00	57	4·8552200
Haystack	280	44	46	101	05	27	4·5801581
Index	295	50	10	116	25	16	4·8594787
Washburne	337	18	01	157	29	37	4·7483054
Blackmore	131	04	26	310	51	46	4·4883949
Gallatin	103	00	05	282	31	59	4·7239772
Bridger	163	01	52	342	51	59	4·7884593
Sawtelle	37	06	05	216	34	50	4·9873343

HAYSTACK.

A peak in Park Co., Mont., on head of East Fork of Main Boulder River, about 2 miles south of Boulder mining camp. Elevation, 10,972 feet.

Permanent mark: Small rock pile 5 feet high.

[Latitude, 45° 11′ 55″·89. Longitude, 110° 13′ 17″·58.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Electric	66	32	06	246	05	55	4·7237827
Emigrant	101	05	27	280	44	46	4·5891581

GRANITE.

A very high, rugged, granite peak on Granite Range in Park Co., Mont., at the head of Rosebud Creek, southwest of Red Lodge and northeast of Cooke City. Has never been occupied. It is the highest peak in Montana. Elevation, 12,824 feet.

[Latitude, 45° 09′ 56″. Longitude, 109° 48′ 22″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Emigrant..........	99	09	57	278	33	35	4·85522

INDEX.

A high, rugged, sharp volcanic peak in Big Horn Co., Wyo., about 10 miles southeast of Cooke City, Mont. It is probably inaccessible. Pilot Peak is a lower point 2 miles north. Elevation, 11,740 feet.

Permanent mark: None.

[Latitude, 44° 58′ 41″·88. Longitude, 109° 52′ 53″·07.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Washburne........	65	44	29	245	21	05	4·6807340
Electric............	92	48	11	272	07	37	4·8777557
Emigrant..........	116	25	16	295	50	10	4·8594787

WASHBURNE.

A round, bare, flat-topped point on Washburne Range in Yellowstone National Park, at head of Antelope Creek. Elevation, 10,000 feet.

Permanent mark: Small rock monument 4 feet high.

[Latitude, 44° 47′ 58″·95. Longitude, 110° 26′ 01″·85.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sheridan...........	7	20	28	187	16	27	4·7747861
Sawtelle...........	72	22	01	251	39	23	4·9255599
Electric............	126	03	32	305	46	26	4·5951298
Index	245	21	05	65	44	29	4·6807340
Yount..............	333	16	43	153	40	33	5·0055609
Emigrant..........	157	29	37	337	18	01	4·7483054

ELECTRIC.

A high volcanic peak in northwest portion of Yellowstone National Park, about one-half mile north of the Montana-Wyoming boundary line. It is 7 miles southwest of Cinnabar, Mont., between heads of Cinnabar and Reese creeks. Elevation, 11,100 feet.

Permanent mark: Small stone monument.

[Latitude, 45° 00′ 27″·04. Longitude, 110° 50′ 15″·05.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sawtelle...........	44	34	57	224	09	18	4·8369594
Hilgard.............	78	52	19	258	25	57	4·5790758
Haystack..........	246	05	55	66	32	06	4·7237827
Index..............	272	07	37	92	48	11	4·8777557
Washburne........	305	46	26	126	03	32	4·5951298
Sheridan...........	343	18	08	163	31	08	4·9330144
Emigrant..........	199	40	54	19	46	27	4·4829363
Gallatin	134	21	07	313	58	38	4·7625041
Blackmore.........	165	05	07	344	58	02	4·7084796

HILGARD.

A high, rugged, basaltic peak in Madison Co., Mont., about 15 miles north of the second canyon of the Madison River. Has not been occupied.

Permanent mark: None.

[Latitude, 44° 55′ 08″·17. Longitude, 111° 27′ 32″·99.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Jefferson	151	01	47	330	38	22	4·9465763
Electric	258	25	57	78	52	10	4·5790758
Gallatin	188	17	41	8	21	39	4·7050281
Emigrant	236	43	32	57	15	30	4·8488356

SAWTELLE.

A bare, round-topped point on Continental Divide, on boundary between Montana and Idaho, southwest of Henry Lake. Has not been occupied. Elevation, 10,000 feet.

Permanent mark: None.

[Latitude, 44° 33′ 56″·05. Longitude, 111° 26′ 40″·33.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Electric	224	09	18	44	34	57	4·8369594
Washburne	251	39	23	72	22	01	4·9255590
Sheridan	294	03	00	114	41	26	4·9033070
Emigrant	216	34	50	37	06	05	4·9873343

SHERIDAN.

Highest peak in Red Mountain Range, Yellowstone National Park, between Heart and Lewis lakes. Elevation, 10,400 feet.

Permanent mark: Small stone monument.

[Latitude, 44° 16′ 06″·02. Longitude, 110° 31′ 44″·81.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sawtelle	114	41	26	294	03	00	4·9033070
Washburne	187	16	27	7	20	28	4·7747361
Yount	300	31	55	120	59	36	4·7906195
Electric	163	31	08	343	18	08	4·9330144

YOUNT.

A high volcanic peak, in Big Horn Co., Wyo., at extreme head of Upper Yellowstone River, between alpine forks of that stream, and 1½ miles north of Continental Divide. Has not been occupied as triangulation station. Elevation, 12,130 feet.

Permanent mark: Stone cairn 5 feet high.

[Latitude, 43° 59′ 02″·76. Longitude, 109° 51′ 58″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Washburne	153	40	33	333	16	43	5·0055609
Sheridan	120	59	36	300	31	55	4·7906195

POWELL.

Highest point of volcanic range in Deer Lodge Co., Mont., 12 southwest of Deer Lodge, between heads of Dempsey and Tin Cu creeks. Elevation, 10,300 feet.

Permanent mark: Stone monument 5 feet high.

[Latitude, 46° 21′ 07″·3. Longitude, 112° 58′ 48″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bitter Root	106	24	20	285	30	35	5·007540
McDonald	148	22	40	328	01	00	5·132300
Keep Cool	192	05	40	12	17	49	4·940526
Mitchell	217	05	20	37	36	06	4·945071
Ox Bow	235	30	50	56	25	13	5·061306
Tweedy	359	19	41	179	20	18	4·985232
Boulder	273	53	35	94	40	17	4·919695

TWEEDY.

Highest point of granite range in Beaver Head Co., Mont., at of Willow Creek, west of Apex Station, Utah and Northern road. Has not been occupied as triangulation station. Elev 11,179 feet.

[Latitude, 45° 28′ 57″·0. Longitude, 112° 57′ 56″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Powell	179	20	18	359	19	41	4·985232
Boulder	221	57	42	42	43	27	5·087647
Jefferson	259	37	42	79	18	33	4·881706

BITTER ROOT.

A high peak on the Bitter Root range, in Missoula Co., Mo miles southwest of Missoula, Mont. Has not been occupied.

[Latitude, 46° 36′ 12″·5. Longitude, 114° 15′ 14″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mitchell	253	39	51	75	06	06	5·19415
Powell	285	30	35	106	24	20	5·00754

McDONALD.

A high, rocky peak in Missoula Co., Mont., probably McDonald Peak, about 15 miles northeast of St. Ignatius Mission, in the Flathead Indian Reservation. Has not been occupied.

[Latitude, 47° 23′ 11″. Longitude, 113° 55′ 18″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Keep Cool	287	56	00	108	47	50	4·97464
Powell	328	01	00	148	22	40	5·13230

KEEP COOL.

On Keep Cool Peak, in Deer Lodge Co., Mont., 10 miles north of Lincoln Gulch (Big Blackfoot drainage.) Elevation, 9,380 feet.

Permanent mark: Stone monument.

[Latitude, 47° 07′ 08″·2. Longitude, 112° 44′ 21″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
McDonald	108	47	50	287	56	00	4·974640
Rocky	176	35	19	356	32	36	4·889359
Ox Bow	284	50	49	105	34	58	4·898867
Mitchell	293	26	41	113	45	55	4·579482
Boulder	324	45	51	145	22	20	5·047500
Powell	12	17	49	192	05	40	4·940526

MITCHELL.

High point on continental divide, 5 miles northwest of Mitchell railroad station, Montana Central Railroad. Grassy ridge. Elevation, 7,800 feet.

Permanent mark: None.

[Latitude, 46° 58′ 56″. Longitude, 112° 16′ 54″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rocky	157	13	44	336	50	54	5·002574
Ox Bow	277	26	34	97	50	36	4·624199
Boulder	339	05	25	159	21	54	4·911482
Powell	37	36	06	217	06	20	4·945071
Bitter Root	75	06	06	253	39	51	5·194150
Keep Cool	113	45	55	293	26	41	4·579482

OX BOW (MOORES MOUNTAIN).

At the head of north fork of Beaver Creek, in Meagher Co., Mont., about 10 miles north of York post-office. There are four peaks near the station of nearly the same elevation; the station is one of the highest ones, farthest northwest. Elevation, 8,000 feet.

Permanent mark: Pile of rocks and poles.

[Latitude, 46° 55′ 54″·8. Longitude, 111° 44′ 01″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rocky	141	00	08	320	13	01	5·103852
Arrow	238	28	50	59	21	57	5·028724
Neihart	266	42	01	87	31	14	4·934222
Elk	304	54	21	125	37	09	4·963010
Boulder	10	31	18	190	23	52	4·856460
Powell	56	25	13	235	30	50	5·061306
Mitchell	97	50	36	277	26	34	4·624190
Keep Cool	105	34	58	284	50	49	4·898867
Crazy	.....	.....	.....	132	40	31	5·178892

LOGAN.

A high peak on the range between the Missouri and Smith r Meagher Co., Mont., about 17 miles northeast of Townsend Has not been occupied. Elevation, 9,400 feet.

Permanent mark: None.

[Latitude, 46° 26′ 03″·5. Longitude, 111° 11′ 10″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Crazy	302	55	07	123	34	32	4·923815
Jefferson	35	12	49	214	37	19	5·046238

ELK.

A large outcrop of rocks at the southwest end of a mou Meagher Co., Mont., 10 miles southeast of White Sulphur There is a small stunted pine near the monument. Elevatio feet.

Permanent mark: A small cairn of rocks.

[Latitude, 46° 27′ 17″·6. Longitude, 110° 45′ 12″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bridger	11	01	56	190	53	58	4·874320
Neihart	191	02	58	11	09	24	4·766779
Big Snowy	252	41	21	.....	.....	.....	5·061627
Crazy	322	31	57	.....	.....	.....	4·783230
Jefferson	46	32	54	225	38	32	5·129725
Boulder	79	08	54	258	18	57	4·955483
Ox Bow	125	37	09	304	54	21	4·963010

CRAZY.

Highest point of Crazy Mountains, in Park Co., Mont., at Big Timber Creek. Elevation, 11,178 feet.

Permanent mark: Large pile of rocks.

[Latitude, 46° 01′ 13″·1. Longitude, 110° 16′ 36″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Livingston	16	40	42	196	32	50	4·696314
Boulder	104	17	41	283	07	19	5·111892
Ox Bow	132	40	31				5·178892
Big Snowy	221	55	45	42	37	36	5·041950
Wilson	289	36	22	110	03	16	4·711123
Pass	340	24	49	160	35	53	4·778444
Emigrant	21	56	57	201	27	56	4·956200
Bridger	64	04	25	243	35	56	4·757050
Logan	123	34	22	302	55	07	4·923815
Gallatin	49	58	48	229	11	32	5·047031
Jefferson	72	03	42	250	48	47	5·152230
Neihart				346	23	58	5·035800
Elk				322	31	57	4·783230

BIG SNOWY.

On highest part of Big Snowy Mountains, in Fergus Co., Mont., south and east of Half Moon Pass. Elevation, 8,600 feet.

Permanent mark: Stone monument 4 feet high.

[Latitude, 46° 45′ 12″·3. Longitude, 109° 18′ 48″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Judith	187	42	20	7	46	24	4·717817
Neihart	104	13	56	283	17	23	5·066122
Crazy	42	37	36	221	55	45	5·041950
Elk				252	41	21	5·061627

JUDITH.

Highest peak of the Judith Mountains (local name, North Pacific Peak), in Fergus Co., Mont., about 15 miles northeast of Lewiston, Mont. Elevation, 6,400 feet.

Permanent mark: Rock monument 15 feet high.

[Latitude, 47° 13′ 07″·9. Longitude, 109° 13′ 15″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Arrow	103	40	18	282	42	30	5·005533
Bear Paw	162	54	03	342	35	03	5·035100
Big Snowy	7	46	24	187	42	20	4·717817
Neihart	75	47	10	254	46	19	5·036097

NEIHART.

A large bald mountain in Meagher Co., Mont., about 8 miles west of south from Glendennin Post-Office (Barker Mining Camp). The station is on the highest part of the mountain, west end. Elevation, 9,200 feet.

Permanent mark: Stone monument.

[Latitude, 46° 58′ 15″·1. Longitude, 110° 36′ 22″·5.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Shaw	121 34 22	300 44 01	5·005403
Arrow	186 44 23	6 47 53	4·709051
Bear Paw	208 24 22	....	5·174812
Judith	254 46 19	75 47 10	5·036097
Big Snowy	283 17 23	104 13 56	5·006122
Crazy	346 23 58	....	5·035800
Elk	11 09 24	191 02 58	4·766779
Boulder	53 26 00	232 29 24	5·095135
Oxbow	87 31 14	266 42 01	4.934222

ARROW.

On Arrow Peak, in Choteau Co., Mont., the second highest p the Highwood Mountains, 5 miles south of east from Highwood between heads of Highwood and North Arrow creeks. Ele 7,420 feet.

Permanent mark: Rock monument.

[Latitude, 47° 25′ 40″·7. Longitude, 110° 31′ 35″·9.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Shaw	91 28 41	270 34 37	4·965291
Teton	114 20 50	....	5·026110
Sweet Grass	158 33 50	337 56 00	5·230678
Bear Paw	218 53 54	39 32 50	5·016239
Neihart	6 47 53	186 44 23	4·709051
Judith	282 42 30	103 40 18	5·005533
Oxbow	59 21 57	238 28 50	5·028724

SHAW.

A mesa butte in Cascade Co., Mont., 6 miles south of Sun Post-Office; station on a grassy knoll on the north part of Elevation, 4,700 feet.

Permanent mark: Stone monument 5 feet high.

[Latitude, 47° 26′ 29″·7. Longitude, 111° 44′ 56″·7.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Teton	172 56 30	....	4·619460
Sweet Grass	190 01 40	10 18 30	5·201000
Bear Paw	242 38 41	....	5·245893
Neihart	300 44 01	121 34 22	5·005403
Arrow	270 34 37	91 28 41	4·965291

TETON.

idge, in Choteau Co., Mont., 20 miles north of Sun River ont., at head of Muddy Creek.

[Latitude, 47° 48′ 48″·0. Longitude, 111° 49′ 02″·4.]

To station.	Azimuth.	Back azimuth.	Log. dist.
		° ′ ″	*Meters.*
Arrow	....	114 20 50	5·026110
Shaw	....	172 56 30	4·619460

ROCKY.

rocky peak on the summit of the range in Choteau Co., 30 miles west of Choteau Post-Office. Has not been

[Latitude, 47° 48′ 53″·5. Longitude, 112° 48′ 03″·1.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Mitchell	336 50 54	157 13 44	5·002574
Keep Cool	356 32 36	176 35 19	4·889359
Oxbow	320 13 01	141 00 08	5·103852

SWEET GRASS.

ed butte in the Sweet Grass Hills in Choteau Co., Mont., sh boundary. Has not been occupied.

[Latitude, 48° 50′ 52″·6. Longitude, 111° 22′ 21″·0.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Arrow	337 56 00	158 33 50	5·230678
Shaw	10 18 30	190 01 40	5·201000

BEAR PAW.

t cone, highest point in the Bear Paw mountains in Mont., about 25 miles southeast of Fort Assinniboine;

[Latitude, 48° 09′ 00″. Longitude, 109° 38′ 58″.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Arrow	39 32 50	218 53 54	5.016239
Judith	342 35 03	162 54 03	5.035100
Neihart	....	208 24 22	5.174812
Shaw	....	242 38 41	5.245893

LIVINGSTON.

it in Park Co., Mont., 7 miles southeast from town of head of Suce Creek. Elevation, 9,400 feet.

Permanent mark: Rock monument 8 feet high.

[Latitude, 45° 35′ 30″·6. Longitude, 110° 27′ 33″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wilson	244	02	24	64	37	03	4.8429796
Pass	284	28	33	104	47	25	4.5506913
Bridger	121	12	24	300	51	52	4.6383223
Crazy	196	32	50	16	40	42	4.6963140

PASS.

Near eastern end of high rocky limestone ridge between tw east branches of East Boulder River, in Yellowstone Co., Mon southern of these two branches is generally dry and has a trail up it and over pass at head to Nye City. Elevation, 9,200 fee

Permanent mark: Rock monument 5 feet high.

[Latitude, 45° 30′ 39″·8. Longitude, 110° 01′ 08″·4.]

To station.	Azimuth.			Back Azimuth.			Log dist.
	°	″	″	°	′	″	*Meters.*
Wilson	215	56	40	36	12	23	4·6852485
White Beaver	237	01	06	57	31	57	4·8231473
Stillwater	255	34	07	75	53	17	4·5573305
Crazy	160	35	53	340	24	49	4·7784442
Livingston	104	47	25	284	28	33	4·5506913

WILSON.

A small butte on large mesa, in Park Co., Mont., east of Swee Creek and south of east fork of Sweet Grass Creek. A road p few hundred yards north and descends into the head of a cany half mile northwest, where there is a spring.

Permanent mark: Stone monument 7 feet high.

[Latitude, 45° 51′ 48″·1. Longitude, 109° 39′ 10″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
White Beaver	276	29	50	96	45	00	4·4401336
Shane	315	55	21	134	17	31	4·7482890
Stillwater	348	06	31	168	10	01	4·4902387
Crazy	110	03	16	289	36	22	4·7111238
Pass	36	12	23	215	56	40	4·6852485
Livingston	64	37	03	244	02	24	4·8429796

STILLWATER.

On bare, grassy hill (limestone), in Yellowstone Co., Mont., northwest of junction of Stillwater River and Rosebud Cre fourth of a mile east is a small pond, and between it and the runs a road to the Yellowstone River.

Permanent mark: Tripod of pine-tree trunks, 10 feet high.

[Latitude, 45° 35′ 28″·0. Longitude, 109° 34′ 16″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
White Beaver	217	47	41	37	59	18	4·5355021
Shane	284	15	46	104	34	23	4·5446244
Pass	75	53	17	255	34	07	4·5573306
Wilson	168	10	01	348	06	31	4·4902387

WHITE BEAVER.

On a high, bare hill east of White Beaver Creek, and about 12 miles north of Yellowstone River. From the point the ridge runs easterly, forming divide between Keyser Creek and Lake Basin. The station is on the boundary between Park and Yellowstone counties, Mont.

Permanent mark: A county monument 3 feet east of the station.

[Latitude, 45° 50′ 05″·2. Longitude, 109° 18′ 01″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Canyon	269	54	18	90	16	04	4·5943859
Boundary	302	15	02	122	45	14	4·8129805
Shane	340	18	14	160	25	16	4·5799908
Wilson	96	45	00	276	29	50	4·4401336
Stillwater	37	50	18	217	47	41	4·5355021
Pass	57	31	57	237	01	06	4·8231473

SHANE.

On highest point of a bare, grassy ridge at head of Shane Creek, in Yellowstone Co., Mont., about 12 miles southeast of Stillwater and 5 miles south of Yellowstone River. An old road running between Shane Creek and Red Lodge passes along ridge, 50 feet south of station. Elevation, 4,955 feet.

[Latitude, 45° 30′ 45″·3. Longitude, 109° 08′ 11″·5.]

Station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Canyon	216	34	01	36	48	42	4·6491423
Boundary	268	37	07	89	00	13	4·6251180
Wilson	134	17	31	313	55	21	4·7482890
White Beaver	160	25	16	340	18	14	4·5799908
Stillwater	104	34	23	284	15	46	4·5446244

CANYON.

On low, small, grassy knoll, in Yellowstone Co., Mont., one-fourth of a mile north of bluff facing south, overlooking basin of Canyon Creek 4 to 5 miles north. Point is about 10 miles east of Coomb's ranch, on south fork of Canyon Creek. A great grassy flat stretches to th and west.

[Latitude, 45° 50′ 03″·2. Longitude, 108° 47′ 40″·9.]

Station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Absaroka	285	01	21	105	29	06	4·7164202
Billings	296	29	56	116	44	22	4·4655250
Mauvais Terre....	309	38	57	129	58	59	4·6749962
Boundary.........	336	04	41	156	13	11	4·5812607
White Beaver	90	16	04	269	54	18	4·5943859
Shane.............	36	48	42	216	34	01	4·6491423

BILLINGS.

On a bald clay butte in Yellowstone Co., Mont., 2½ miles east Creek and 6 miles south of Billings and 2 miles southwest of ro Yellowstone ferry to Pryor Creek.

[Latitude, 45° 42′ 59″·3. Longitude, 108° 27′ 32″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Absaroka	271	19	46	91	33	05	4·3826370
Mauvais Terre....	329	17	20	149	22	57	4·3011815
Canyon...........	116	44	22	296	29	56	4·4655250
Boundary.........	26	19	05	206	13	10	4·3855090

BOUNDARY.

On a high mesa between Pryor Creek and Clark's Ford divid miles west of Pryor Creek. It is at the head of Blue Creek, west boundary line of the Crow Indian Reservation, in Montana. the station the mesa drops down abruptly on the south.

Permanent mark: Box elder tree in center of stone monume

[Latitude, 45° 31′ 13″·7. Longitude, 108° 35′ 48″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Billings	206	13	10	26	19	05	4·3855090
Absaroka.	238	36	17	58	55	29	4·6111079
Mauvais Terre....	257	36	15	77	47	46	4·3320681
White Beaver	122	45	14	302	15	02	4·8129805
Shane	89	00	13	268	37	07	4·6251180
Canyon	156	13	11	336	04	41	4·5812607

MAUVAIS TERRE.

On high grassy ridge or mesa in Crow Indian Reservation, between drainage of Fly Creek and East Fork (dry) of Pryor s east of Pryor Creek. The station is on the edge of the bluff overlooking East Fork.

[Latitude, 45° 38′ 41″·9. Longitude, 108° 19′ 41″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Absaroka	219	50	09	40	10	49	4·3362426
Mesa	231	35	54	51	56	32	4·6782773
Far West	262	16	35	82	39	53	4·6313331
Boundary	77	47	46	257	36	15	4·3320681
Canyon	129	58	59	309	88	57	4·6749062
Billings	149	22	57	[illegible]	17	20	4·3011815

ABSAROKA.

nd of mesa between Fly and Pryor creeks, in Crow Indian Montana, near head of Indian Creek and 5 miles south Fort Custer road.

[Latitude, 45° 42′ 39″·7. Longitude, 108° 08′ 56″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mesa	241	06	23	61	19	21	4·4279156
Far West	291	01	30	111	17	09	4·4838382
Billings	91	33	05	271	19	46	4·3826370
Mauvais Terre	40	10	49	219	59	09	4·3362426
Boundary	58	55	29	238	36	17	4·6111079
Canyon	105	29	06	285	01	21	4·7164202

MESA.

e south end of Pine Ridge, in Crow Indian Reservation, iles north of Billings and Fort Custer road.

[Latitude, 45° 49′ 37″·5. Longitude, 107° 50′ 50″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ryan	253	53	04	74	10	06	4·5042215
Abbott	294	09	15	114	29	12	4·5980025
Far West	348	25	01	168	27	43	4·3871966
Absaroka	61	19	22	241	06	23	4·4279156
Mauvais Terre	51	56	32	231	35	54	4·6782773
North Point	271	51	48	92	00	34	4·2006290
South Point	323	16	24	143	22	07	4·2908080

ABBOTT (ABBOTT'S URN).

nmost of four buttes, in Crow Indian Reservation, Monto 8 miles north of Crow Indian Agency and 2 to 3 miles Fort Custer and Fort Keogh road. There is a peculiar stone pinnacle on southeast slope.

Permanent mark: Rock monument 6 feet high.

[Latitude, 45° 40′ 48″·8. Longitude, 107° 22′ 59″·5]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rotten Grass	21	15	56	201	08	11	4·5927058
Far West	76	32	06	256	14	53	4·5077235
Pine Ridge	147	55	20	327	43	26	4·6056647
Custer	325	33	07	145	37	31	4·1510686
Rosebud	338	07	45	158	15	55	4·6037525
Mesa	114	29	12	294	09	15	4·5980025
South Point	95	24	57	275	10	45	4·4128460
North Point	128	03	24	307	52	13	4·4092320
Ryan	168	00	11	347	57	14	4·4094129

NORTH POINT.

In Crow Indian Reservation, Mont., on first bench, three-fourths of a mile west of Big Horn River and 5 miles below Fort Custer Ferry.

Permanent mark: A steel wagon axle 3 inches in diameter, set 2 feet in the ground and projecting a few inches above, with cross cut on upper surface.

[Latitude, 45° 49′ 20″·10. Longitude, 107° 38′ 35″·41.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Abbott	307	52	13	128	03	24	4·409232
East Base	336	51	34	156	54	04	4·063616
South Point	22	21	49	202	18	52	4·160826
West Base	28	19	54	208	17	48	3·903846
Mesa	92	60	34	271	51	48	4·200629

SOUTH POINT.

In Crow Indian Reservation, Mont., on a small butte 8 miles southwest of Fort Custer and 3 miles south of Billings and Fort Custer road.

Permanent mark: A steel wagon axle 3 inches in diameter, set 2 feet in the ground and projecting a few inches above, with cross cut on upper surface.

[Latitude, 45° 42′ 06″·21. Longitude, 107°, 42′ 50″·11.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	′	°	′	″	*Meters.*
Mesa	143	22	07	323	16	24	4·239808
West Base	195	01	21	15	02	17	3·817202
North Point	202	18	52	22	21	49	4·160826
East Base	254	40	37	74	46	10	3·818203
Abbott	275	10	45	95	24	57	4·412846

EAST BASE.

In Crow Indian Reservation, Mont., about 100 yards from west bank of Big Horn River, opposite Fort Custer, and three-fourths of a mile above Fort Custer Ferry.

Permanent mark: A 4-inch cast-iron pipe with cap, set 3 feet in the ground and projecting about 1 foot above, with cross cut on upper surface of cap.

[Latitude, 45° 43′ 35″·21. Longitude, 107° 35′ 05″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
South Point	74	46	10	254	40	37	3·818203
West Base	113	18	40	293	14	02	3·958681
North Point	156	54	04	336	51	34	4·063616

WEST BASE.

In Crow Indian Reservation, Mont., about 6½ miles northwest of Fort Custer and 2 miles north of Billings and Fort Custer road. One-eighth of a mile north is a spring in dry cañyon.

Permanent mark: A 4-inch cast-iron pipe with cap, set 3 feet in the ground and projecting about 1 foot above, with cross cut on upper surface of cap.

[Latitude, 45° 45′ 31″·57. Longitude, 107° 41′ 31″·38.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
North Point	208	17	48	28	19	54	3·903846
East Base	293	14	02	113	18	40	3.958681
South Point	15	02	17	195	01	21	3·817202

RYAN.

On high mesa in Crow Indian Reservation, Montana, about 5 miles east of stage station on Big Horn River, between Custer Station and Fort Custer.

[Latitude, 45° 54′ 22″·1. Longitude, 107° 27′ 07″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Far West	38	29	14	218	14	56	4·6199678
Pine Ridge	119	21	28	299	12	31	4·2662940
Terry	158	46	01	338	39	29	4·5088867
West Base	159	50	08	339	54	41	4·3670918
East Base	168	43	45	348	40	58	4·4085105
Abbott	347	57	14	168	00	11	4·4094429
Mesa	74	10	06	253	53	04	4·5042215

PINE RIDGE.

On east slope of Pine Ridge, in Crow Indian Reservation, Montana, about 10 miles west of Custer Station.

Permanent mark: A peculiar spreading pine tree, 1½ feet in di
leaning down hill.

[Latitude, 45° 59′ 14″·6. Longitude, 107° 39′ 34″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Terry	191	40	18	11	42	44	4·3322294
West Base	212	11	24	32	15	55	4·1813560
Far West	13	08	51	193	03	29	4·6317223
Ryan	299	12	31	119	21	28	4·2662940
Abbott	327	43	26	147	55	20	4·6056647

WEST BASE (CUSTER STATION).

In Crow Indian Reservation, Mont., on highest point (west
mesa, south of Custer Station, about 2½ miles west of stage ro
from 3 to 4 miles from Custer Station.

[Latitude, 46° 06′ 10″·6. Longitude, 107° 33′ 18″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Terry	155	32	32	335	30	27	3·9547039
East Base	222	20	57	42	22	36	3·6427125
Pine Ridge	32	15	55	212	11	24	4·1813560
Ryan	339	54	41	159	59	08	4·3670918

EAST BASE (CUSTER STATION).

On edge of mesa, in Crow Indian Reservation, Mont., 2 miles
east of Custer Station and two-thirds of a mile east of Fort Cust
road.

[Latitude, 46° 07′ 55″·7. Longitude, 107° 31′ 00″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Terry	126	33	21	306	29	36	3·9203511
Ryan	348	40	58	168	43	45	4·4085105
West Base	42	22	36	222	20	57	3·6427125

TERRY.

On south edge of partly timbered mesa, in Yellowstone Co.,
4 miles north of Yellowstone River, at Custer Station. The dr
age which heads at south foot of mesa, near signal, enters Yello
River half a mile above ferry, at Junction City.

[Latitude, 46° 10′ 36″·2. Longitude, 107° 36′ 12″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Base	306	29	36	126	33	21	3·9203511
West Base	335	30	27	155	32	32	3·9547039
Ryan	338	39	29	158	46	01	4·5088867
Pine Ridge	11	42	44	191	40	18	4·3322294

FAR WEST.

just east of large mesa, in Crow Indian Reservation, Mont., s west of Big Horn River and 13 miles southwest of Fort

[Latitude, 45° 36′ 43″·5. Longitude, 107° 47′ 04″·3.]

Station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Ridge	193	03	29	13	08	51	4·6317223
Custer	275	47	06	96	08	42	4·5970066
Rosebud	302	48	28	122	53	48	4·7404811
Rotten Grass	329	09	57	149	19	22	4·5270876
Absaroka	111	17	09	291	01	30	4·4838382
Ryan	38	29	14	218	14	56	4·6199678
Abbott	256	14	53	76	32	06	4·5077235
Mauvaise Terre	82	39	53	262	16	35	4·6313331
Mesa	168	27	43	348	25	01	4·3871966

CUSTER.

ndian Reservation, Mont., on a rocky butte 8 miles east of y, partly timbered below, and having a large sandstone the summit. A road leaving the Crow Agency and going age immediately opposite runs directly to the station.

[Latitude, 45° 34′ 30″·4. Longitude, 107° 16′ 50″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Reno	16	38	43	196	31	41	4·6548219
Rotten Grass	41	54	45	221	42	37	4·5223663
Rosebud	344	52	50	164	56	36	4·4234948
Abbott	145	37	31	325	33	07	4·1510836
Far West	96	08	42	275	47	06	4·5970066

ROTTEN GRASS.

assy butte on divide just east of Rotten Grass Creek, in Reservation, Mont. It is 3 miles east of Rotten Grass es southeast of Xavier Mission, and 3 miles north of road Grass Creek to Lodge Grass Creek.

[Latitude, 45° 21′ 06″·6. Longitude, 107° 33′ 51″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Reno	336	06	05	153	11	09	4·3160829
Far West	149	19	22	329	09	57	4·5270876
Custer	221	42	37	41	54	45	4·5223663
Rosebud	271	24	40	91	40	33	4·4649032
Abbott	201	08	11	21	15	56	4·5927058

ROSEBUD.

On partly timbered point in Rosebud Mountains, in Crow Indian Reservation, Mont., 8 miles north of east of mouth of Lodge Grass Creek, at head of Snake Creek. There are wood roads crossing the ridge on each side (north and south) of the station, one running up Snake Creek and the other up a creek which enters the Little Horn just above the mouth of Lodge Grass Creek.

[Latitude, 45° 20′ 41″·2. Longitude, 107° 11′ 32″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Red Bluff	00	01	58	180	01	57	4·5326235
Little Horn	30	26	46	210	16	37	4·5684396
Reno	48	22	56	228	12	09	4·4246037
Rotten Grass	91	40	33	271	24	40	4·4649032
Custer	164	56	36	344	52	50	4·4234948
Far West	122	53	48	302	48	28	4·7404811
Abbott	158	15	55	338	07	45	4·6037525

RENO.

On west end of mesa, in Crow Indian Reservation, Mont., 3 miles west of Little Horn Canyon. There is a high, flat-topped butte 8 miles west, and a high mesa beyond this, sloping to Lodge Grass Creek. The station Mesa is between the second and third large drainages south of Lodge Grass Creek.

[Latitude, 45° 11′ 08″·3. Longitude, 107° 26′ 42″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Red Bluff	309	26	16	129	37	00	4·4111685
Little Horn	355	21	13	175	21	50	4·1554425
Rotten Grass	153	11	09	333	06	05	4·3160829
Cloud Peak	346	17	44				4·9625670
Custer	196	31	41	16	38	43	4·6548219
Rosebud	228	12	09	48	22	56	4·4246037

LITTLE HORN.

In Crow Indian Reservation, Mont., on grassy butte (steep on south with road at foot), between Little Horn and Pass creeks, 3½ miles southwest of stage station and about 2 miles north of Wyoming-Montana line.

[Latitude, 45° 03′ 26″. Longitude, 107° 25″ 49″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Red Bluff	276	26	58	96	37	04	4·2756655
Rosebud	210	16	37	30	26	46	4·5684396
Reno	355	21	13	175	21	50	4·1554425

RED BLUFF.

On large red hill, in Crow Indian Reservation, Mont., at south end of Rosebud Range, 1½ miles east of Owl Creek and 2 miles north of Wyoming-Montana line.

Permanent mark: Tripod of pine trees and stones.

[Latitude, 45° 02′ 16″·9. Longitude, 107° 11′ 38″·3.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Reno	129 37 00	309 26 16	4·4111685
Rosebud...........	180 01 57	000 01 58	4·5326235
Little Horn.......	96 37 04	276 26 58	4·2756655

CLOUD PEAK.

The highest peak of the Big Horn Mountains, Wyo., about 24 miles west of Fort McKinney, Wyo., and probably on boundary line between Big Horn and Johnson counties. It has not been occupied and is poorly located. Elevation, 12,926 feet.

Permanent mark: A large cairn of rocks on the summit.

[Latitude, 44° 23′ 00″·2. Longitude, 107° 10′ 23″·0.]

To station.	Azimuth.	Back azimuth.	Log. dist.
		° ′ ″	*Meters.*
Reno	....	346 17 44	4·962567

IDAHO.

METHODS OF WORK.

The triangulation in Idaho covers an area of about 1 miles, in the form of a parallelogram, 100 miles in breadth in length, in the center of the southern part of the Sta from the western boundary as far east as Hailey. Work the summer of 1889 and continued during the seasons of

A base line 4¾ miles in length was measured near B triangulation expansion from this base governs the topog In the measurement of the base a steel tape line 100 feet i used with a resulting probable error of 0.19 foot. In the telegraphic connection was had with the observatory at S astronomical observations were taken to determine the pier near the west end of the Boise base and the initial angulation.

In expanding this base a 7-inch theodolite, reading to 10 used during the seasons of 1889 and 1890. During the sea and 1892 a 10-inch theodolite, with micrometer microsco to 2 seconds, was used. Circle readings, direct and rever general order of procedure, and as a rule angles were measu points, without artificial signals, these signals not being bu station was occupied, the natural points generally being determinate. In a few instances in which the object sighte good natural point, signals were built before observations

During the period of use of the 7-inch theodolite the fi adjusted by the method of least squares. When the 10-inc was used arbitrary adjustments were made.

The triangulation and base measurements were made by Griswold or one of his assistants, Messrs. E. T. Perkins or F The astronomical work was performed by Prof. R. S. Woodwa by Mr. Griswold, in conjunction with Prof. H. S. Pritchett, a

DESCRIPTIONS AND POSITIONS OF STATIO

MIDDLE WEISER.

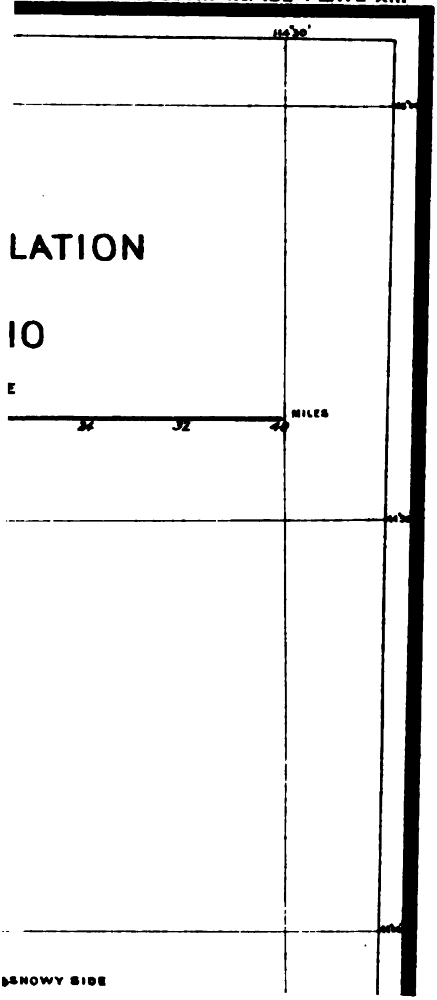
A high, sharp mountain on ridge between Long Valley River and the head of Middle Weiser, in Washington Co., I

Permanent mark: Rock cairn.

[Latitude, 44° 42′ 37″·77. Longitude, 116° 16′ 14″·15.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Willow	14	24	12·51	194	16	38·23	4·7626201
Packer John	326	48	12·80	147	07	56·62	4·8461400

BULLETIN No. 122 PLATE XIII



WEISER.

On Sage Brush Hill, in Washington Co., Idaho, 6 miles northeast of the city of Weiser.

[Latitude, 44° 15′ 56″·2. Longitude, 116° 54′ 5″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Squaw	306	34	51·68	126	55	17	4·6886081
Mitchell	22	15	40·00	202	04	09	4·7741042

BIG WILLOW.

A round, bald knob on ridge between Weiser River and Squaw Creek in Washington Co., Idaho, at head of Big Willow Creek.

Permanent mark: A pile of rocks 7 feet high and 5 feet at base.

[Latitude, 44° 12′ 20″·60. Longitude, 116° 27′ 02″·71.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Squaw	352	18	29·30	172	20	04·48	4·3572383
Packer John	272	44	06·00	93	11	43·84	4·7233831
Middle Weiser	194	16	38·23	14	24	12·51	4·7626201

SQUAW.

Station on the southeast end of a flat-topped mountain in Ada Co., Idaho, about 6 miles north of Emmet.

[Latitude, 44° 00′ 09″·66. Longitude, 116° 24′ 45″·96.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lucky Peak	327	21	34·40	147	36	06·81	4·7193885
Star	000	42	21·25	180	42	11·51	4·4065461
Weiser	126	55	17·00	306	34	51·68	4·6886081
Big Willow	172	20	04·48	352	18	29·30	4·3572383
Packer John	248	06	19·28	68	32	19·09	4·7296846

PACKER JOHN.

Highest round peak on range between Deadwood River and Gordon Valley, in Boise Co., Idaho, reached by trail from Gordon Valley to Deadwood to summit, thence 1½ miles northwest on ridge of mountain.

Permanent mark: A stake driven in flat surface, about 5 feet square, amidst a group of rocks. Reference mark: A lone tree about 5 feet north of station.

[Latitude, 44° 10′ 52″·00. Longitude, 115° 47′ 24″·25.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Squaw	68	32	19·09	248	06	19·28	4·7296846
Shafer	27	59	17·03	207	46	46·40	4·7119787
Big Willow	93	11	43·84	272	44	06·00	4·7233831
Middle Weiser	147	07	56·62	326	48	12·80	4·8461400

SNOWY SIDE.

A high granite peak at head waters of South Boise, Paye
Solomon rivers, in Alturas Co., Idaho, about 15 miles west
Tooth City.

Permanent mark: A small stone monument.

[Latitude, 43° 56′ 16″·25. Longitude, 114° 58′ 21″·50.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
North	44	30	08·63	224	11	09·28	4·7218576
Smoky Dome	356	42	29·43	176	43	56·91	4·6948826

MITCHELL.

On Mitchell Butte, in Malheur Co., Oreg., just north of Owyhe

Permanent mark: A large pile of rocks.

[Latitude, 43° 46′ 12″·59. Longitude, 117° 10′ 52″·19.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pickels	309	31	40·33	129	51	01·33	4·6903732
Caldwell	280	23	51·60	100	43	58·32	4·5991384
Weiser	202	04	09·00	22	15	40·00	4·7741042

CALDWELL.

A low sage brush hill on the north bench of the Boise River,
Co., Idaho, about 2 miles north of Caldwell, just where the
crosses the river.

[Latitude, 43° 42′ 16″·52. Longitude, 116° 41′ 46″·82.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Star	251	12	45·26	71	24	21·35	4·3762960
Pickels	3	21	32·51	183	20	49·25	4·3813222
Mitchell	100	43	58·32	280	23	51·60	4·5991384

STAR.

On sand ridge 3 miles to the north of Star post-office, A
Idaho.

Permanent mark: A wooden stake.

[Latitude, 43° 46′ 23″·49. Longitude, 116° 25′ 00″·00.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lucky Peak	303	05	54·18	123	20	34·46	4·5329758
S. Ridge No. 1	332	09	34·49	152	17	21·30	4·5122886
Squaw	180	42	11·51	000	42	21·25	4·4065461
Pickels Butte	37	15	21·63	217	03	03·62	4·5987971
Caldwell	71	24	21·35	251	12	45·26	4·3762960
Initial Point	357	47	50·18	177	48	42·66	4·6495464

SHAFER.

ky point on mountains north of Boise City, in Boise Co., 1 of Shafer Creek.

mark: Rock monument 6 feet high.

[Latitude, 43° 46′ 16″·45. Longitude, 116° 05′ 25″·26.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Lucky Peak	353	06	10·16	173	07	18·99	4·2697214
South Ridge No. 1.	21	24	21·58	201	18	37·63	4·4867354
Flat Top..........	48	58	55·18	228	26	01·53	4·9328902
Cinder	352	46	41·85	172	50	39·05	4·7915183
House.............	307	33	50·99	127	58	43·23	4·7881882
North.............	289	35	18·35	110	02	39·92	4·7526931
Camas	317	25	28·28	137	52	30·77	4·8953144
Packer John	207	46	46·40	27	59	17·03	4·7119787

WEST BASE.

Boise base is located about 2 miles southwest of Boise
Co., Idaho, on the second bench from the river, in a sage

mark: A copper bolt sunk in a dressed block of sand-

[Latitude, 43° 35′ 14″·19. Longitude, 116° 14′ 49″·70.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
tronomical Pier....	240	18	12·14	60	19	25·00	3·4359450
st Base..............	307	28	48·49	127	31	54·61	3·8830977
ith Ridge No. 1.....	349	39	06·42	169	39	51·93	3·9170050
ble Rock...........	265	19	26·19	85	23	37·41	3·9138471

EAST BASE.

the Boise base is located on a rocky point about 6 miles
Boise City, in Ada Co., Idaho, on the second bluff above
e to the old overland road where it climbs the bluff and
oad.

nark: A copper bolt sunk in a sandstone rock.

[Latitude, 43° 32′ 43″·47. Longitude, 116° 10′ 19″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
tronomical Pier....	148	26	41·15	328	24	47·84	3·8479314
est Base............	127	31	54·61	307	28	48·49	3·8850977
ith Ridge No. 1....	52	50	22·17	232	48	01·67	3·7596442

ASTRONOMICAL PIER.

mical station from which the positions of all triangula-
n Idaho were determined is on the plains south of Boise
o., Idaho, in the NW. ¼, sec. 16, T. 3 N., R. 2 E. of Boise

Meridian, being 50 feet south of the Nampa Land, Lumber and tion Company's canal and 200 feet east of county road from Kuna. It is marked by one cubic yard of cemented concret the ground, upon which is built a brick pier laid in cement. tude determined by telegraphic connection with Saint Louis, R. S. Woodward and W. T. Griswold. Latitude determined by method.

[Latitude, 43° 35′ 57″·98. Longitude, 116° 13′ 04″·04.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Base.........	328	24	47·84	148	26	41·15	3·8479314
West Base.........	60	19	25·00	240	18	12·14	3·4359450

TABLE ROCK.

Located on the southeast end of table rock, a prominent la 2 miles east of Boise City, in Ada Co., Idaho.

Permanent mark: A rock monument, 6 feet high, 5 feet base.

[Latitude, 43° 35′ 35″·69. Longitude, 116° 08′ 45″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
South Ridge No. 1.	37	19	39·31	217	16	13·76	4·0433493
West Base.........	85	23	37·41	265	19	26·19	3·9138471
South Ridge No. 2.	348	37	33·79	168	38	55·03	4·1284681

LUCKY PEAK.

A round-topped bald mountain, called Shaws Mountain, in A Idaho, between Moores Creek and Boise River.

Permanent mark: A rock monument 6 feet high, 5 feet base.

[Latitude, 43° 36′ 17″·84. Longitude, 116° 03′ 45″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
South Ridge No. 1.	53	07	21·29	233	00	29·19	4·2251047
South Ridge No. 2.	15	45	31·35	195	43	26·13	4·1773476
Three Point......	316	51	44·90	136	57	00·58	4·1775766
Shafer............	173	07	18·99	353	06	10·16	4·2697214
Star	123	20	34·46	303	05	54·18	4·5329758
Squaw............	147	36	06·81	327	21	34·40	4·7193885
Quicksilver.......	35	05	16·65	214	40	44·51	4·9274756
Initial Point......	46	12	04·46	225	58	20·50	4·5722373

SOUTH RIDGE NO. 1.

Located on a salient of the third bluff, in Ada Co., Idaho, the Boise River.

mark: A 2-inch stake driven in the ground.

[Latitude, 43° 30′ 50″·88. Longitude, 116° 13′ 43″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
West Base........	169	39	51·93	349	39	06·42	3·9170050
East Base	232	48	01·67	52	50	22·17	3·7596442
Cable Rock.......	217	16	13·76	37	19	39·31	4·0433493
South Ridge No. 2.	295	05	57·87	115	10	44·46	4·0141441
Lucky Peak......	233	00	29·19	53	07	21·29	4·2251047
Star	152	17	21·30	332	09	34·49	4·5122886
Shafer.............	201	18	37·63	21	24	21·58	4·4867354
Pickels Butte	85	59	47·65	265	39	45·80	4·5947018

SOUTH RIDGE NO. 2.

ividing ridge between Indian Creek and Boise River, in
o, one-fourth mile south of overland road.
mark: A 2-inch stake driven in ground.

[Latitude, 43° 28′ 28″·67. Longitude, 116° 06′ 47″·39.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
able Rock.......	168	38	55·03	348	37	33·79	4·1284681
outh Ridge No. 1.	115	10	44·46	295	05	57·87	4·0141441
ucky Peak	195	43	26·13	15	45	31·35	4·1773476
hree Point	256	18	09·94	76	25	30·34	4·1701353

THREE POINT.

of a group of three bald mountains on the south of the
Elmore Co., Idaho, between the heads of Grouse Creek
eek.
mark: A small stone monument.

[Latitude, 43° 30′ 21″·70. Longitude, 115° 56′ 07″·48.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
ucky Peak	136	57	00·58	316	51	44·90	4·1775766
outh Ridge No. 2.	76	25	30·34	256	18	09·94	4·1701353

PICKELS BUTTE.

e on the north bank of Snake River, in Ada Co., Idaho,
north of Warm Spring ferry.

[Latitude, 43° 29′ 18″·21. Longitude, 116° 42′ 49″·56.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
tar	217	03	03·62	37	15	21·63	4·5987971
outh Ridge No. 1.	265	39	45·80	85	59	47·65	4·5947018
aldwell..........	183	20	49·25	3	21	32·51	4·3813222
itchell	129	51	01·33	309	31	40·33	4·6903732

INITIAL POINT.

Small black butte on Snake River plains, in Ada Co., Idaho from Kuna (south) Station on Oregon Short Line Railroad. Init of the land survey of Idaho.

[Latitude, 43° 22′ 18″·20. Longitude, 116° 23′ 42″·80.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lucky Peak	225	58	20·50	46	12	04·46	4·5722373
Star	177	48	42·68	357	47	50·18	4·6495404

FLAT TOP.

A long, flat-topped mountain in Owyhee Co., Idaho, locall as Squaw Mountains, between Reynold Creek and Jump Cree head of Squaw Creek.

Permanent mark: A monument of slab rock at the south en mountain.

[Latitude, 43° 15′ 44″·31. Longitude, 116° 53′ 11″·56.]

To station.	Azimuth,			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shafer	228	26	01·53	48	58	55·18	4·9328902
Cinder	273	31	17·91	94	07	57·53	4·8609823
Quicksilver	329	21	45·09	149	31	04·79	4·5611815

QUICKSILVER.

Highest peak to the northeast of Silver City, Owyhee Co., I

Permanent mark: A large stone monument.

[Latitude, 42° 58′ 48″·47. Longitude, 116° 39′ 32″·46.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Flat Top	149	31	04·79	329	21	45·09	4·5611815
Lucky Peak	214	40	44·51	35	05	16·65	4·9274756

CINDER.

Cinder Cone, 200 feet high, in Ada Co., Idaho, 12 miles sout Cleft, a station on Union Pacific Railroad.

Permanent mark: A rock monument 8 feet high.

[Latitude, 43° 13′ 07″·26. Longitude, 115° 59′ 40″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shafer	172	50	39·05	352	46	41·85	4·7915183
Flat Top	94	07	57·53	273	31	17·91	4·8609823
House	239	42	37·95	60	03	26·16	4·6756929

NORTH.

Highest peak in Granite range, in Elmore Co., Idaho, between Smith Prairie and Trinity lakes, three-fourths of a mile to east from the trail to Smith Prairie from Rocky Bar.

Permanent mark: A large sharp-pointed rock on highest peak.

[Latitude, 43° 35′ 54″·90. Longitude, 115° 25′ 48″·56.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shafer	110	02	39·92	289	35	18·35	4·7526931
House	14	33	10·22	194	30	43·82	4·2795957
Camas	000	40	04·62	180	39	50·79	4·5898895
Green Springs	315	28	31·54	135	49	49·15	4·7770614
Smoky Dome	286	16	52·80	106	37	14·71	4·6182232
Snowy Side	224	11	09·28	44	30	08·63	4·7218576

HOUSE.

A bald mountain in the bend of the South Boise River, in Elmore Co., Idaho, between Smith Prairie and Little Camas Prairie.

Permanent mark: A monument of stone on west end.

[Latitude, 43° 25′ 57″·75. Longitude, 115° 29′ 21″·53.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shafer	127	58	48·23	307	33	50·99	4·7881882
Cinder	60	03	26·16	239	42	37·95	4·6756929
North	194	30	43·82	14	33	10·22	4·2795957

CAMAS.

High bald mountain between Mountain Home and Camas Prairie, in Elmore Co., Idaho, 2 miles east of road from Mountain Home to Rocky Bar.

Permanent mark: A stone monument 7 feet high.

[Latitude, 43° 14′ 54″·66. Longitude, 115° 26′ 08″·64.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shafer	137	52	30·77	317	25	28·26	4·8953144
North	180	39	50·79	000	40	04·62	4·5898895
Smoky Dome	235	55	54·90	56	16	26·69	4·6871167

SMOKY DOME.

A dome-shaped peak in the range to the north of Camas Prairie about north of Soldier Creek, in Logan Co., Idaho.

Permanent mark: A stone monument.

[Latitude, 43° 29′ 33″·93. Longitude, 114° 56′ 14″·94.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
North	106	37	14·71	286	16	52·80	4·6182232
Camas	56	16	26·69	235	55	54·90	4·6871167
Green Springs	356	26	17·82	176	27	16·58	4·4927915
Kelly Mountain	269	59	16·56	90	18	39·94	4·5795620
Snowy Side	176	43	56·91	356	42	29·43	4·6948826

KELLY MOUNTAIN.

High bald peak, northwest from Hailey Hot Springs, in Logan Co., Idaho, on same mountain as Red Elephant Mine.

Permanent mark: Rock monument.

[Latitude, 43° 29′ 30″·71. Longitude, 114° 28′ 04″·61.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Smoky Dome	90	18	39·94	269	59	16·56	4·5795620
Green Springs	49	34	58·31	229	16	36·68	4·6773992

GREEN SPRINGS.

High flat mountain, in Logan Co., Idaho, on ridge between Camas Prairie and King Hill Creek, about 4 miles south of Camas Prairie.

Permanent mark: A large stone monument.

[Latitude, 43° 12′ 48″ ·03. Longitude, 114° 54′ 49″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
North	135	49	49·15	315	28	31·54	4·7770614
Smoky Dome	176	27	16·58	356	26	17·82	4·4927915
Kelly Mountain ..	229	16	36·68	49	34	58·31	4·6773992

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CALIFORNIA, NEVADA, AND SOUTHERN OREGON.

METHODS OF WORK.

The triangulation of California is in three separate and independent sections, namely, the Cascade section, in northern California and southern Oregon; the Gold Belt section, including the Sierras from Red Bluff to Yosemite Valley, and from the Sacramento Valley eastward well into Nevada. The third section includes a few stations in the Coast Range, southeast of San Francisco.

The first work was done in 1882 and continued in 1883 by Gilbert Thompson in the vicinity of Mount Shasta. Work was carried forward in this section by Mark B. Kerr and Eugene Ricksecker until 1886 and by W. T. Griswold in 1887. All distances, azimuths, and positions depend on the position of Lassen and on the line Lassen–Shasta, as computed by E. M. Douglas from unclosed triangles of the U. S. Coast and Geodetic Survey. The instrument used was an 8-inch 10-second vernier theodolite. Natural points were generally sighted and single and double angles measured by circle readings. The work was all adjusted by least squares.

In the Gold Belt section work was commenced in 1885 by H. M. Wilson, who measured a base line with steel tape near Oroville for temporary use. The distances thus obtained were afterwards replaced by others depending on the U. S. Coast and Geodetic Survey transcontinental line Marysville Butte-Pine Hill, afterwards checked by the lines between Lola, Pine Hill, Round Top and Pah Rah and Como. The instrument used for nearly all the work was an 8-inch 10-second theodolite. A few angles were measured in 1885 with a 7-inch theodolite. The method of circle readings was generally adopted for measuring angles, and least-square adjustment was made for station and figure.

During the years from 1889 to 1893 the triangulation was carried on by H. E. C. Feusier, who located points as far south as the Yosemite Valley and eastward into Nevada to Walker Lake. A few stations in California and Nevada, in the vicinity of Taylorsville, Cal., were occupied in 1890 by E. M. Douglas, using an 8-inch micrometer theodolite. The initial stations for this work were Lola–Pah Rah, two stations of the U. S. Coast and Geodetic Survey transcontinental triangulation.

In this work good, bare, natural peaks were found on nearly all of the stations occupied in the Oregon and Nevada portions of the work. On these, stone monuments were erected to mark the stations and serve as signals. In the Gold Belt work, however, many of the hills were timbered or were so flat on top as to require the construction of special signals. In some cases these consisted of trimmed trees to mark the station and serve as signals. In a few instances, high observing scaffolds were built, notably in the case of Pike County Peak, where the signal was placed on such a scaffold 66 feet in height. In many of the cases where the hills were heavily timbered, heliotropes were used extensively as signals and the stations marked by small cairns of rock.

DESCRIPTIONS AND POSITIONS OF STATIONS.

SCOTT.

Sharp point in Klamath Co., Oreg., 2 miles east of Crater Lake.

[Latitude, 42° 55′ 18″·9. Longitude, 122° 01′ 00″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pitt	24	53	30	204	41	19	4·7675002

HIGH ROCK.

Situated in Lake Co., Oreg., about 16 miles northeast of Bly.

[Latitude, 42° 29′ 42″·7. Longitude, 120° 52′ 40″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pitt	87	42	17	266	44	00	5·0734618
Baldy	342	33	06	162	39	32	4·6428586

PITT.

A sharp point in Jackson Co., Oreg., 12 miles due west of Klamath Lake. Elevation, 9,760.

[Latitude, 42° 26′ 36″·4. Longitude, 122° 18′ 58″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shasta	354	58	25	175	03	16	5·0625150
Thompson	19	29	14	199	01	49	5·2386588
High Rock	266	44	00	87	42	17	5·0734618
Baldy	284	48	52	105	53	22	5·1356498
Scott	204	41	19	24	53	30	4·7675002
Hoffman	325	26	50	145	57	28	5·0494781
Kerby	75	35	29	254	49	12	4·9897085
Preston	58	08	48	237	16	37	5·1029871

KERBY.

High point on north end of ridge, 10 miles east of Kerby, Josephine Co., Oreg.

[Latitude, 42° 13′ 08″·2. Longitude, 123° 27′ 42″·6.]

To station.	Azimuth.			Back azimuth.			Log. dis.
	°	′	″	°	′	″	*Meters.*
Preston	16	18	25	196	12	22	4·6189509
Pitt	254	49	12	75	35	29	4·9897085

BALDY.

Prominent butte 6 miles southeast of Fall River Mills, Shasta Co., Cal.

[Latitude, 42° 07′ 03″·7. Longitude, 120° 43′ 06″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pitt	105	53	22	284	48	52	5·1356498
Hoffman	51	09	25	230	35	59	4·9512523
High Rock	162	39	32	342	33	06	4·6428586

PRESTON.

High peak in Siskiyou Range, at the head of Preston Creek, Del Norte Co., Cal.

[Latitude, 41° 50′ 01″·7. Longitude, 123° 36′ 44″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pitt	237	16	37	58	08	48	5·1029871
Thompson	331	47	06	152	11	18	5·0356372
Kerby	196	12	22	16	18	25	4·6489509

HOFFMAN.

Rounded butte in Siskiyou Co., Cal., 1 mile northeast of Medicine Lake.

[Latitude, 41° 36′ 35″·7. Longitude, 121° 33′ 13″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pitt	145	57	28	325	26	50	5·0494781
Shasta	67	27	32	247	02	02	4·7639981
Baldy	230	35	59	51	09	25	4·9512523

SHASTA.

The highest peak in northern California, in Siskiyou Co., 6 miles northeast of Berryvale.

[Latitude, 41° 24′ 27″·6. Longitude, 122° 11′ 42″·9.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Linn	20	17	26	199	51	37	5·2103160
Thompson	54	39	51	234	07	57	4·9207588
Pitt	175	03	16	354	58	25	5·0625150
Hoffmann	247	02	02	67	27	32	4·7639981

THOMPSON.

Sixteen miles north of Junction City, in Trinity Co., Cal.

[Latitude, 40° 58′ 15″·2. Longitude, 123° 00′ 09″.9.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Pitt	199	01	49	19	29	14	5·2386588
Shasta	234	07	57	54	39	51	4·9207588
Lassen	292	32	14	113	30	51	5·1381783
Preston	152	11	18	331	47	06	5·0356372

LASSEN.

Highest peak in Shasta Co., Cal.

[Latitude, 40° 29′ 12″·0. Longitude, 121° 30′ 19″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Linn	66	49	53	245	57	34	5·0978405
Thompson	113	30	51	292	32	14	5·1381783

LINN.

Highest peak in the Yallo Bally Mountains, Tehama Co., C
its boundary with Trinity County.

[Latitude, 40° 02′ 05″·7. Longitude, 122° 51′ 16″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lassen	245	57	34	66	49	53	5·0978405
Shasta	199	51	37	20	17	26	5·2103160

STATE LINE PEAK.

Local name, Fort Sage Peak. Highest point of mountain. I
of Long Valley Post-Office (Doyle's ranch).

Permanent mark: Rock monument, about in center of hillto

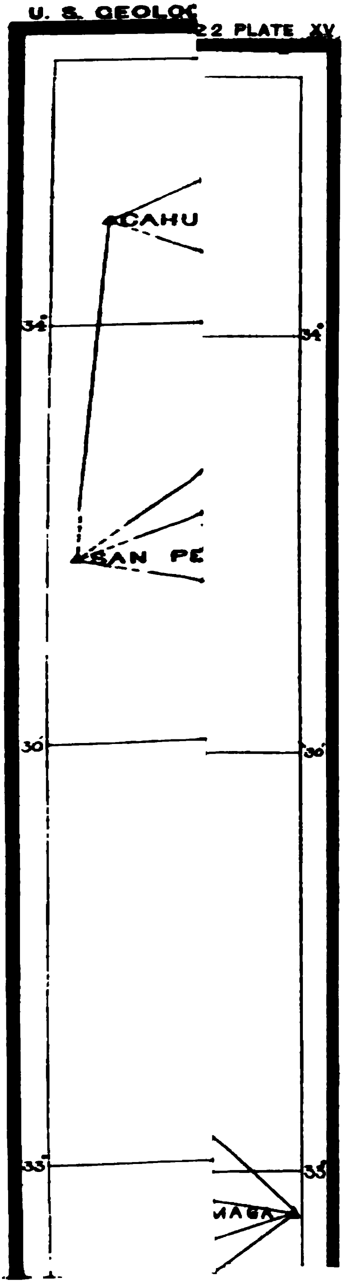
[Latitude, 40° 01′ 42″·1. Longitude, 119° 58′ 45″·4.]

MOUNT INGALLS.

A high, bare-topped peak about 20 miles from Beckwith po
down Red Clover Valley and 6 miles west of Chase's ranch.

Permanent mark: A rock monument.

[Latitude, 39° 59′ 33″·7. Longitude, 120° 37′ 40″·1.]



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OMJUMI PEAK.

Local name, Dixie Peak. Highest peak on west side of Last Chance Valley. Station is about the center one, of three or four equally high peaks close together.

Permanent mark: Stone cairn.

[Latitude, 39° 56′ 14″·18. Longitude, 120° 17′ 08″·0.]

PAH RAH (C. AND G. S. STATION).

[Latitude, 39° 47′ 34″·73. Longitude, 119° 28′ 28″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lola	62	35	59·68	242	01	55·06	4.9364404

SUMMIT.

A station of the Wheeler survey; the westernmost of two high rocky peaks, about 2 miles north of where old stage road from Long Valley Creek to Loyalton crosses the divide.

Permanent mark: A rock cairn about 8 feet high.

[Latitude, 39° 42′ 03″·5. Longitude, 120° 08′ 37″·3.]

BIG BAR HILL.

A high, round topped, heavily timbered hill in Butte Co., Cal., 8 miles north of Merrimac Mills and 6 miles northwest of Mountain House.

Permanent mark: Cairn of rocks under observing tripod, 15 feet high, beneath two tall firs on highest point of hill.

[Latitude, 39° 46′ 32″·7. Longitude, 121° 25′ 40″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marysville Butte	28	11	22	207	56	22	4·8566666
Fillmore	275	51	43	96	13	46	4·6950446
Chico	81	00	23	260	44	17	4·5615898

CHICO.

In Butte Co., Cal.

Permanent mark: Flagstaff in center of top of waterworks tower, near railroad depot.

[Latitude, 39° 43′ 25″·2. Longitude, 121° 50′ 51″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marysville Butte	357	42	48	177	43	49	4·7611889
Big Bar Hill	260	44	17	81	00	23	4·5615898

FILLMORE.

A high, bare-topped peak, situated in Sierra Co., Cal., 3 miles east of Howland Flat and 4 miles southeast of Gibsonville. Scattering timber on west side of hill.

Permanent mark: A pile of brush and rocks 10 feet high on highest point.

[Latitude, 39° 43′ 43″·5. Longitude, 120° 51′ 10″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marysville Butte	55	21	43	234	44	48	5·0070456
Banner Hill	10	16	15	190	11	56	4·7376420
Big Bar Hill	96	13	46	275	51	43	4·6950446

PEAVINE MOUNTAIN.

In Washoe Co., Nev., 7 miles northwest of the town of Reno, Nev., and 6 miles northeast of the town of Verdi, Cal.

Permanent mark: Rock monument.

[Latitude, 39° 35′ 07″·4. Longitude, 119° 55′ 57″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rose	357	24	14	177	24	47	4·4316384
Tibbie Peak	304	54	18	125	09	27	4·6204635

PIKE COUNTY PEAK.

High, timbered hill in Yuba Co., Cal., about 4 miles east of Brownsville and 1 mile southeast of Challenge Mills.

Permanent mark: Center of 66-foot spruce stump in center of 64-foot scaffold of standing stumps.

[Latitude, 39° 28′ 24″·3. Longitude, 121° 12′ 10″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marysville Butte	60	55	31	240	32	00	4·7860026
Banner Hill	321	09	27	141	18	28	4·5135932

LOLA.

U. S. C. & G. S. station, in Nevada Co., Cal. The south summit of the high ridge between Weber and Independence lakes, from either of which it can be reached.

Permanent mark: A cairn of rocks 10 feet high, under which is U. S. C. & G. S. drill hole.

[Latitude, 39° 25′ 53″·3. Longitude, 120° 21′ 55″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Hill	34	32	04	214	08	25	4·9819924
Marysville Butte	79	06	06	258	10	46	5·1078108
Round Top	339	37	56	159	51	42	4·9592252
Banner Hill	68	18	57	247	56	07	4·7464188
Pah Rah	242	01	55	62	36	00	4·9364404

TIBBIE PEAK.

A high, bare, and rocky twin peak in Storey Co., Nev.; highest point on Flowery Ridge, 7 miles northwest of Virginia City. Station is on eastern and highest twin summit.

Permanent mark: Monument of rock 7 feet high.

[Latitude, 39° 22′ 10″·7. Longitude, 119° 32′ 07″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rose	84	52	08	264	37	33	4·5204370
Como	352	15	00	172	17	18	4·5931781
Cleaver Peak	296	56	53	116	12	09	4·5861595
Peavine Mountain	125	09	27	304	54	18	4·6204635

ROSE.

A peak on bare ridge, west of Washoe Valley, and 6 miles east by north from the town of Washoe, in Washoe Co., Nev.

Permanent mark: Rock monument.

[Latitude, 39° 20′ 32″·3. Longitude, 119° 55′ 05″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Genoa	354	35	29	174	36	52	4·5255739
Como	312	52	50	133	09	39	4·7199236
Peavine Mountain	177	24	47	357	24	14	4·4316384
Tibbie Peak	264	37	33	84	52	08	4·5204370
Twin Peak	46	38	52	226	26	57	4·5722948

CLEAVER PEAK.

Often called Wabuska hill; a bare, rocky, flat topped peak, 6 miles east of north of the town of Wabuska, in Lyons Co., Nev.

Permanent mark: A cairn of rocks 8 feet high.

[Latitude, 39° 13′ 01″·1. Longitude, 119° 08′ 01″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Como	53	29	16	233	16	22	4·5645136
Tibbie Peak	116	12	09	295	56	53	4·5861595
Black Mountain	327	57	11	148	05	37	4·5612553

BANNER HILL.

Station is about 3 miles southeast of Nevada City, Cal., and 5 miles northeast of Grass Valley, in Nevada Co.

Permanent mark: A large dead oak tree, marked U. S. G. S.

[Latitude, 39° 14′ 39″·4. Longitude, 120° 57′ 56″·6.]

To station.	Azimuth.			Back azjmuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald Mountain	329	12	26	149	22	17	4·6446840
Rock Mountain	48	11	46	228	01	40	4·4914659
Lola	247	56	07	68	18	57	4·7464188
Pine Hill	2	07	57	182	07	01	4·7669790
Duncan Peak	285	53	09	106	10	27	4·6129787
Fillmore	190	11	56	10	16	15	4·7376420
Pike County Peak	141	18	28	321	09	27	4·5135932
Marysville Butte	86	50	11	266	17	44	4·8691326

MARYSVILLE BUTTE.

U. S. C. & G. Survey station, in Sutter Co., Cal., 10 miles north of west from Marysville and 5 miles southeast of Colusa.

Permanent mark: The southern and next to highest rock cropping on South Butte, the highest of the group.

[Latitude, 39° 12′ 15″·7. Longitude, 121° 49′ 15″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Banner Hill	206	17	44	86	50	11	4·8691326
Capitol	337	47	17	157	59	36	4·8772911
Big Bar Hill	207	56	22	28	11	22	4·8566666
Chico	177	43	49	357	42	48	4·7611889
Fillmore	234	44	48	55	21	43	5·0070456
Lola	258	10	46	79	06	06	5·1073108
Pike County Peak	240	32	00	60	55	31	4·7860026
Pine Hill	306	37	37	127	08	57	4·9540856

DUNCAN PEAK.

Rocky and bare projection of a square partly timbered hill in Placer Co., 20 miles east of Iowa Hill, 25 miles northeast of Michigan Bluffs, and 8 miles southeast of Indian Springs.

Permanent mark: The highest point of the rock on southwest part of the hill.

[Latitude, 39° 08′ 32″·1. Longitude, 120° 30′ 33″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Banner Hill	106	10	27	285	53	09	4·6129737
Bald Mountain	32	35	05	212	27	41	4·4991272

TWIN PEAK.

This station is a bare rocky peak on a timbered ridge at the head of Blackwood Creek, 4 miles west of Lake Tahoe and 6 miles southwest of Tahoe city, in Placer Co., Cal.

Permanent mark: Rock monument.

[Latitude, 39° 06′ 39″·3. Longitude, 120° 13′ 56″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Genoa	284	08	30	104	21	45	4·4954839
Rose	226	26	57	46	38	52	4·5722948
Round Top	338	01	12	158	09	54	4·7299713
Robbs Peak	35	34	38	215	28	09	4·4078178

ROCK MOUNTAIN.

High bare hill in Nevada Co., Cal., 4 miles southwest of Spencerville and 12 miles east of Wheatland.

Permanent mark: Top of large bare rocky knob on summit.

[Latitude, 39° 03′ 28″·0. Longitude, 121° 18′ 58″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Hill	330	49	41	150	58	48	4·6353051
Banner Hill	228	01	40	48	11	46	4·4914659

GENOA PEAK.

In Douglas Co., Nev.; bare rocky cone on ridge between Carson Valley and Lake Tahoe and 4 miles northwest of the town of Genoa.

Permanent mark: Rock monument.

[Latitude, 39° 02′ 29″·5. Longitude, 119° 52′ 54″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Round Top	13	53	09	193	48	39	4·6372704
Como	273	46	30	94	01	54	4·5485606
Rose	174	36	52	354	35	29	4·5255739
Twin Peak	104	21	45	284	08	30	4·4954839

COMO.

U. S. C. & G. S. station on the Como Mountains, lying between Carson and Mason valleys, in Douglas Co., Nev. It is a bare, sharp cone, about 30 miles by road from either Carson City or Dayton. There is a spring and camping ground at the head of Pine Mount Valley. From this place a trail leads to the summit.

Permanent mark: Stone monument, 12 feet high, over U. S. C. & G. S. mark.

[Latitude, 39° 01′ 11″·4. Longitude, 119° 28′ 27″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Round Top	49	12	53	228	53	03	4·7823826
Genoa Peak	94	01	54	273	46	30	4·5485606
Black Mountain	280	16	25	100	37	41	4·6958039
Cleaver Peak	233	16	22	53	29	16	4·5645136
Desert Creek Peak	343	02	38	163	08	36	4·6744512
Highland Peak	24	51	48	204	41	13	4·7663800
Leviathan	17	43	54	197	38	43	4·5952729
Rose	133	09	39	312	52	50	4·7199236
Tibbie Peak	172	17	18	352	15	00	4·5931781
Mount Wilson	310	37	13	130	46	47	4·4625328

BLACK MOUNTAIN.

A long timbered ridge in Walker River range of mountains. It lies between Mason Valley and Walker Lake, 15 miles southeast of town of Mason Valley (Poison Switch), in Esmeralda Co., Nev., and 10 miles south of west of Rio Vista railroad station. Summit cleared of timber.

Permanent mark: A lone tree.

[Latitude, 38° 56′ 19″·4. Longitude, 118° 54′ 39″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cleaver Peak	148	05	37	327	57	11	4·5612553
Como	100	37	41	280	16	25	4·6958039

MOUNT WILSON.

A bare peak, the northernmost summit of the range between Warm Spring Valley and Mason Valley, and 3 miles northeast of Wilson's ranch. In Lyon Co., Nev., on north side of Walker River.

Permanent mark: Rock monument.

[Latitude, 38° 50′ 57″·9. Longitude, 119° 13′ 14″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Como	130	46	47	310	37	13	4·4625328
Desert Creek Peak	17	32	28	197	28	53	4·4405014

ROBBS PEAK.

A brush-covered hill in Eldorado Co., Cal., 24 miles east by north from Georgetown, near the Uncle Tom's Cabin road, 1½ miles west of Orellis Dairy ranch.

Permanent mark: Rock monument.

[Latitude, 38° 55′ 24″·3. Longitude, 120° 24′ 14″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Round Top	309	32	58	129	48	06	4·6573774
Twin Peak	215	28	09	35	34	38	4·4078178
Alder Hill	341	31	45	161	36	28	4·5390325

BALD MOUNTAIN.

High, heavily timbered point, in Eldorado Co., Cal., about 7 miles east of Georgetown. Nearest camp at Twelve Mile House.

Permanent mark: A stone cairn between two blazed pine trees.

[Latitude, 38° 54′ 09″·2. Longitude, 120° 42′ 19″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duncan	212	27	41	32	35	05	4·4991272
Baltic Peak	324	41	42	144	48	49	4·4552510
Pine Hill	50	30	12	230	19	28	4·5074335
Banner Hill	149	22	17	329	12	26	4·6446840

PINE HILL.

U. S. C. & G. S. station, situated in Eldorado Co., Cal., 6 miles east of Salmon Falls and 3 miles northeast of Green Valley. Highest part of peak is bare.

Permanent mark: A cairn of rocks on northernmost of two rock croppings, situated 30 feet apart and on highest summit of hill.

[Latitude, 38° 43′ 04″·4. Longitude, 120° 59′ 26″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Banner Hill	182	07	01	2	07	57	4·7669790
Marysville Butte	127	08	57	306	37	37	4·9540856
Bald Mountain	230	19	28	50	30	12	4·5074335
Baltic Peak	273	43	37	94	01	26	4·6170650
Capitol	70	16	26	249	57	35	4·6681981
Crossman	305	10	38	125	27	45	4·6885248
Jackson Butte	330	46	53	150	56	57	4·6832661
Lola	214	08	25	34	32	04	4·9819924
Rock Mountain	150	58	48	330	49	41	4·6353051

BALTIC PEAK.

The westernmost and highest spur of Baltic Ridge, situated in Eldorado Co., Cal., 4 miles due north of Grizzly Flat and 4 miles southeast of Sly Park.

Permanent mark: A cairn of rocks. There is a blazed oak 5 feet west of this cairn.

[Latitude, 38° 41′ 33″·6. Longitude, 120° 30′ 57″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Hill	94	01	26	273	43	37	4·6170650
Bald Mountain	144	48	49	324	41	42	4·4552510
Crossman	3	29	42	183	29	03	4·4060125

ROUND TOP.

U. S. C. & G. S. station, situated in Alpine Co., Cal., about 4 miles south by west from Carson Pass and 6 miles east of Silver Lake, 4 miles southeast of Kirkwood's (on Amador road).

Permanent mark: Stone monument over U. S. C. & G. S. mark.

[Latitude, 38° 39′ 43″·6. Longitude, 120° 00′ 05″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Como	228	53	03	49	12	53	4·7823826
Genoa	193	48	39	13	53	09	4·6872703
Robbs Peak	129	48	06	309	32	58	4·6573774
Twin Peak	158	00	54	338	01	12	4·7299713
Alder Hill	81	05	05	260	54	43	4·3870881
Highland Peak	301	49	44	121	58	56	4·4011548
Lola	159	51	42	339	37	56	4·9592252
Mokelumne	30	20	24	210	16	54	4·2075502

LEVIATHAN.

In Alpine Co., Cal., a bare peak on ridge east of Antelope Valley and northwest of the lower end of Slinkards Valley. It is 6 miles southwest of the Mountain House.

Permanent mark: A rock monument.

[Latitude, 38° 40′ 54″·7. Longitude, 119° 36′ 43″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Desert Creek Peak	286	31	52	106	42	58	4·4297204
Como	197	38	43	17	43	54	4·5952729

DESERT CREEK PEAK.

A bare peak, the northernmost of the ridge between Desert Creek and the Carson-Aurora road. It is 3 miles south of Hall and Simpson's ranch, in Lyon Co., Nevada.

Permanent mark: A rock monument.

[Latitude, 38° 36′ 45″·2. Longitude, 119° 18′ 58″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Como	163	08	36	343	02	38	4·6744512
Highland Peak	78	37	23	258	20	55	4·5923509
Mount Wilson	197	28	53	17	32	28	4·4405014
Leviathan	106	42	58	286	31	52	4·4297204

ALDER HILL (OFTEN CALLED LEAK SPRING HILL).

A timbered hill at the head of the north fork of the Cosumne River, 11 miles due east from Grizzly Flat and 10 miles west by south from Silver Lake, in Eldorado Co., Cal.

Permanent mark: A tree with limbs trimmed off and marked U. S. G. S.

[Latitude, 38° 37′ 40″·0. Longitude, 120° 16′ 41″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Round Top	260	54	43	81	05	05	4·3870881
Robbs Peak	161	36	28	341	31	45	4·5390325

CAPITOL.

The center of cupola of capitol building at Sacramento, Cal.

[Latitude, 38° 34′ 30″·7. Longitude, 121° 29′ 38″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Hill	249	57	35	70	16	26	4·6681981
Jackson Butte	291	03	20	111	32	00	4·8595054
Marysville Butte	157	59	36	337	47	17	4·8772911

SUGAR LOAF.

A high cone in Eldorado Co., Cal., 4 miles east of Latrobe.

Permanent mark: A lone digger pine which is blazed and has a cairn of rocks built against it. This tree is 35 feet east of the highest rock cropping on the hill and 8 feet below the summit.

[Latitude, 38° 34′ 43″·0. Longitude, 120° 56′ 59″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Buena Vista	354	51	13·55	174	52	32·79	4·5385235
Jackson Butte	323	09	16·23	143	17	47·43	4·5222831

MOKELUMNE.

A bare rocky peak on the north side of Mokelumne River Canyon and 9 miles due south from Silver Lake.

Permanent mark: Rock monument.

[Latitude, 38° 32′ 12″·12. Longitude, 120° 05′ 41″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Highland Peak ...	268	42	34	88	55	14	4·4705789
Round Top	210	16	54	30	20	24	4·2075502
Dardanelle Cone..	307	17	38	127	25	56	4·3377463

HIGHLAND PEAK.

A bare rocky peak 8 miles west of Hermit Valley and 10 miles south of Markleeville, in Alpine Co., Cal. Local name is South Silver Mountain.

Permanent mark: Rock monument.

[Latitude, 38° 32′ 31″·9. Longitude, 119° 45′ 21″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Como	204	41	13	24	51	48	4·7663800
Round Top	121	58	56	301	49	44	4·4011548
Dardanelle Cone......	33	24	30	213	20	10	4·2666422
Desert Creek Peak....	258	20	55	78	37	23	4·5923509
Mokelumne...........	88	55	14	268	42	34	4·4705789
Sonora.................	333	31	32	153	35	01	4·3718484

CROSSMAN.

The highest point on wooded rise or knoll on the first ridge south of Sutter Creek, known as Crossman Mount or Mount Heckler. Twenty miles east of Jackson, on Antelope Spring road, or 7 miles a little south of east of Volcano and 1½ miles northwest of Whitmore's sawmill. Hill covered with undergrowth and some timber.

Permanent mark: A small cairn of rocks.

[Latitude, 38° 27′ 49″·2. Longitude, 120° 32′ 01″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pine Hill.........	125	27	45	305	10	38	4·6885248
Baltic Peak.......	183	29	03	3	29	42	4·4060125
Blue Mountain...	312	50	09	132	56	25	4·3025616
Jackson Butte....	49	47	25	229	40	25	4·3326197

DARDANELLE CONE.

A bare lava cone, 4 miles north by east from the junction of the middle fork of the Stanislaus and Clark's fork of the Stanislaus. Bloods Station on Big Tree road is 12 miles northwest.

Permanent mark: A rock monument.

[Latitude, 38° 24′ 11″·5. Longitude, 119° 52′ 20″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Highland Peak …	213	20	10	83	24	30	4·2666422
Mokelumne…….	127	25	56	307	17	38	4·3877463
Bear Mountain …	55	54	12	235	17	44	4·8787191
Sonora…………	……	……	……	105	21	40	4·3309599

SONORA.

[Latitude, 38° 21′ 08″·25. Longitude, 119° 38′ 09″·18.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dardanelle Cone..	105	21	39·62	……	……	……	4·3309599
Highland Peak …	153	35	00·82	333	31	32·06	4·3718484

BLUE MOUNTAIN.

In Calaveras Co., Cal., between north and middle forks of Mokelumne River, on a very prominent hill, locally known as Blue Mountain, about 5 miles due north of Big Trees and 8 miles south of east of West Point. Station on summit of highest rock cropping on Blue Mountain.

[Latitude, 38° 20′ 26″·2. Longitude, 120° 21′ 55″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Jackson Butte….	89	39	47	269	26	32	4.4933875
Crossman………	132	56	25	312	50	09	4·3025616
Bear Mountain….	28	28	57	208	20	46	4·6083280
Joaquin ………	51	42	48	231	30	44	4·5598667

JACKSON BUTTE.

Is situated in Amador Co., Cal., 3 miles southeast of Jackson, on an isolated, conical, very steep hill. It is covered with scattered timber which has been cleared from the summit, leaving a single tall oak as a signal.

Permanent mark: A + on a copper bolt, 34 feet north of signal tree, the bolt projecting three-quarters of an inch above surface rock; over this are two flat stones and a cairn of rocks.

[Latitude, 38° 20′ 18″·3. Longitude, 120° 43′ 17″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Crossman	229	40	25·00	49	47	25·00	4·3326197
Pine Hill	150	56	57·00	330	46	53·00	4·6832661
Blue Mountain	269	26	32·00	89	39	47·00	4·4933875
Buena Vista	65	22	42·00	245	15	32·00	4·2687901
Joaquin	352	59	35·00	173	00	47·00	4·3514767
Sugar Loaf	143	17	47·43	323	09	16·23	4·5222831
Capitol	111	32	09·00	291	03	20·00	4·8595054

BUENA VISTA.

Situated on center of north side of prominent hill locally known as Buena Vista Butte, in Amador Co., Cal., 5½ miles south of Ione and 1 mile south of Buena Vista.

Permanent mark: Tall, lone Digger pine tree on north central side of butte, blazed and marked U. S. G. S. This tree is 125 feet east and 10 feet below the highest rock outcropping of the hill.

[Latitude, 38° 16′ 06″·8. Longitude, 120° 54′ 51″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Joaquin	306	27	26·00	126	35	45·00	4·3879729
Jackson Butte	245	15	32·00	65	22	42·00	4·2687901
Sugar Loaf	174	52	32·79	354	51	13·55	4·5385235

JOAQUIN.

In Calaveras Co., Cal., 3½ miles south of San Andreas, on southernmost high point of Hogback Ridge. Station on the high, rocky outcrop rising from the north end of a thicket of chaparral. Finders, a clump of trees 300 yards north of station on highest point of summit.

[Latitude, 38° 08′ 15″·2. Longitude, 120° 41′ 24″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blue Mountain	231	30	44	51	42	48	4·5598667
Jackson Butte	173	00	47	352	59	35	4·3514767
Buena Vista	126	35	45	306	27	26	4·3879729

BEAR MOUNTAIN.

Highest point on ridge, 5 miles southwest of Angels, in Calaveras Co., Cal.

[Latitude, 38° 01′ 08″·5. Longitude, 120° 35′ 08″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Blue Mountain	208	20	46	28	28	57	4·6083280
Dardanelle Cone	235	17	44	55	54	12	4·8787191
Big Hill	356	05	15	176	05	51	4·3296475

BIG CANYON.

Local name, Duckwall Mount; a high timbered point on a ridge, 14 miles east of Sonora in Tuolumne Co., Cal.

[Latitude, 37° 58′ 01″·5. Longitude, 120° 07′ 18″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Big Hill	68	38	35	248	22	02	4·6276730
Moccasin Peak	45	19	41	225	12	01	4·4116285
Bullion Peak	355	04	57	175	06	34	4·6590366
Pilot Peak	324	39	25	144	46	11	4·4473833

COTTONWOOD PEAK.

In Tuolumne Co., Cal., immediately south of Hetch-Hetchy Valley and Tuolumne River.

[Latitude, 37° 55′ 30″·9. Longitude, 119° 44′ 07″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Conness	262	51	29	83	06	45	4·5639041
Hoffman	114	13	52	294	05	36	4·3353253

CONNESS.

A primary station of the U. S. C. & G. S., 10 miles north of Soda Springs, Mono Co., Cal. In shape an irregular parallelogram of granite; from northwest portion rises the top of peak with precipitous side of 1,000 feet or more.

Permanent mark: Concrete pier with five-eighths copper bolt in center.

[Latitude 37° 57′ 56″·0. Longitude 119° 19′ 18″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hoffman	51	21	09	231	14	11	4·3288340
Cottonwood Peak	83	06	45	262	51	29	4·5639041

MOUNT DANA.

Large, bare, somewhat irregular peak with cone-shaped top, covered with broken sandstones and granite, in Tuolumne Co., Cal.

Permanent mark: Stone monument about 6 feet high.

[Latitude, 37° 53′ 54″·3. Longitude, 119° 13′ 17″·4]

To station.	Azimuth.			Back azimuth			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lyell	14	01	13	193	59	22	4·2637680
Hoffman	77	05	00	256	54	20	4·4171931

HOFFMAN.

About 2 miles west of Lake Tenaiaya and 39 miles from Sequoia, o the west of Tioga road, in Tuolumne Co., Cal. The mountain has thre sharp ridges of granite, and the point occupied is the highest and far thest to the west. On this ridge is Chimney Rock, a cylinder of granit rising from main ledge to height of 60 feet, and it is north of this tha station occupied is situated.

Point marked thus:

· N
U. S. G. S.
+
<6·5>
W+<6·5 ft.>+<6·5 ft.>E.
<6·5>
S

A monument about 5 feet high over the center mark.

[Latitude, 37° 50′ 43″·5. Longitude, 119° 30′ 39″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Mount Dana	256	54	20	77	05	00	4·4171931
Conness	231	14	11	51	21	09	4·3288840
Clarks Peak	336	34	42	156	37	42	4·2597
Cottonwood Peak	294	05	36	114	13	52	4·3353926
							253

BIG HILL.

In Tuolumne Co., Cal., 6 miles east of Knights Ferry and 6 miles wes of the Crimea House.

[Latitude, 37° 49″ 37″·3. Longitude, 120° 34′ 08″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bear Mountain	176	05	51	356	05	15	4·3296475
Big Canyon	248	22	02	68	38	35	4·6276730
Bullion	304	21	06	124	39	12	4·7224157
Moccasin Peak	276	57	29	97	06	20	4·3291570

MOCCASIN PEAK.

A potato-shaped peak, slightly flattened on top, covered with oa timber. It is situated on southwest side of Moccasin Creek, abov Hugh's place, close to bridge across Moccasin Creek, in Tuolumne Co., Cal.

Permanent mark: Bull-pine tree about 40 feet high, 2 feet in diameter.

[Latitude, 37° 48′ 12″·5. Longitude, 120° 19′ 43″·0.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Big Hill	97 06 20	276 57 29	4·3291570
Big Canyon	225 12 01	45 19 41	4·4116285
Pilot Peak	277 38 19	97 52 44	4·5424939

PILOT PEAK.

On boundary of Mariposa and Tuolumne counties, Cal. Rose's ranch is 2½ miles east.

[Latitude, 37° 45′ 39″·8. Longitude, 119° 56′ 10″·9].

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Moccasin Peak	97 52 44	277 38 19	4·5424939
Big Canyon	144 46 11	324 39 25	4·4473833
Devils Peak	326 16 40	146 23 49	4·4928478

CLARKS PEAK.

An obelisk-shaped peak on north end of Merced Group, in Mariposa Co., Cal., at head waters of Merced River, about 11 miles southeast of Yosemite. The peak is merely a sharp ridge; there is not space enough on top to stand tripod.

Permanent mark: Monument of stone about 4 feet high.

[Latitude, 37° 41′ 42″·0. Longitude, 119° 25′ 44″·1.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Devils Peak	56 07 20	235 55 55	4·5212361
Hoffman	156 37 42	336 34 42	4·2597926

MOUNT LYELL.

Situated 14 miles southeast of Soda Springs, at end of Tuolumne Meadows, in Mono Co., Cal. In shape very irregular; the south side a perpendicular wall, the north a series of meadows till the glacier is reached; the east and west sides are rather steep. The highest point is a short, sharp ridge about 200 yards long, running northwest and south-east, the northwest end being the lower.

Permanent mark: Small stone monument; U. S. G. S. chiseled on rock east of it.

[Latitude, 37° 44′ 16″·6. Longitude, 119° 16′ 19″·0.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Mount Dana......	193 59 22	14 01 13	4·2637680

BULLION PEAK.

A high point on a timbered ridge, 15 miles north of east of Merced Falls, 2 miles east of Bear Valley, in Mariposa Co., Cal.

[Latitude, 37° 33′ 27″·6. Longitude, 120° 04′ 33″·7.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Big Hill...........	124 39 12	304 21 00	4·7224157
Big Canyon	175 06 34	355 04 57	4·6590366

DEVILS PEAK.

A cone on southeast end of short potato-shaped ridge, 9 miles southwest of Wawona Peak; bare on top and covered with loose rock.

Permanent mark: Fir tree, about 30 feet high, placed in center of monument, 5·6 feet west of U. S. G. S. chiseled on rock.

[Latitude, 37° 31′ 40″·2. Longitude, 119° 44′ 26″·9.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Pilot Peak.........	146 23 49	326 16 40	4·4928478
Clark's Peak......	235 55 55	56 07 20	4·5212361

LAWSON HILL.

At north end of flat ridge, North of Bear Creek (a north branch of San Pablo Creek).

Permanent mark: A 4 by 4 stake (pine) in middle of pile of stones, about 50 feet southwest of large oak tree on edge of steep slope. Hill is timbered on north slope.

[Latitude, 37° 56′ 34″. Longitude, 122° 11′ 36″.]

To station.	Azimuth.	Back azimuth.	Log. dist.
	° ′ ″	° ′ ″	*Meters.*
Bald	20 53 59	200 52 55	3·8552896
Striped Hill.......	94 27 02	273 23 32	3·9211217

STRIPED HILL.

A bare, round hill at northern end of ridge between Wild Cat and San Pablo creeks. Small slide on west slope from which the station is named.

[Latitude, 37° 56′ 49″. Longitude, 122° 17′ 17″.]

To station.	Azimuth			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Yerba Buena.....	24	07	15	204	04	22	4·2271188
Rocky Island.....	45	51	57	225	49	27	3·9195784
Lawson Hill......	273	23	32	94	27	02	3·9211217

ROCKY ISLAND.

Highest point of Rocky or Sheep Island, Bay of San Francisco.

Permanent mark: Cross cut in rock.

[Latitude, 37° 53′ 42″. Longitude, 122° 21′ 21″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Striped Hill......	225	49	27	45	51	57	3·9195784

BALD.

[Latitude, 37° 52′ 56″·19. Longitude, 122° 13′ 20″·48.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lawson Hill......	200	52	55	20	53	59	3·8552896
Mulholland Hill..	291	40	28	111	43	22	3·8742967
Yerba Buena.....	56	57	37	237	01	00	4·1788065

MULHOLLAND HILL.

Highest point on ridge south of road through Moroga Valley, about one-half mile south of residence of Mr. Mulholland; one small oak tree on north side of point; distance from station about 50 feet.

Permanent mark: Mound of stones.

[Latitude, 37° 51′ 26″. Longitude, 122° 08′ 36″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald..............	111	43	22	291	40	28	3·8742967
Redwood.........	33	10	03	213	08	49	3·7315417

MONUMENT SOUTH.

[Latitude, 37° 50′ 55″·08. Longitude, 122° 11′ 35″·52.]

REDWOOD.

Highest point on ridge between Contra Costa and Alameda counties Cal., covered with redwood timber and sandstone rocks, about three fourths of a mile southwest of Redwood Canyon.

Permanent mark: Redwood tree, 15 feet high and 6 inches in diameter, marked U. S. G. S. Southwest of which, and about 2 feet distant is large sandstone marked U. S. G. S.

[Latitude, 37° 49′ 00″. Longitude, 122° 10′ 37″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Yerba Buena.....	86	52	49	266	45	50	4·2230198
Mulholland Hill...	213	08	49	33	10	03	3·7315417

YERBA BUENA.

Highest point of Yerba Buena, or Goat Island, Bay of San Francisco U. S. Coast and Geodetic Survey Point.

[Latitude, 37° 48′ 30″. Longitude, 122° 21′ 59″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bald..............	237	01	00	56	57	37	4·1788065
Striped Hill......	204	04	22	24	07	15	4·2271188
Redwood..........	266	45	50	86	52	49	4·2230198

SOUTHERN CALIFORNIA.

METHODS OF WORK.

The triangulation in southern California was begun in July, 1891, and covers an area of about 5,000 square miles. The line Wire-Kelly, as fixed by positions obtained from the U. S. Coast and Geodetic Survey, was taken as the basis of the work of 1891, which includes the line Wire-Mora and all points south of that line. Subsequent work depends upon the line Southeast Base-San Juan, as given by the same organization. The instrument used in this work was an 8-inch nonrepeating theodolite reading by micrometer to two seconds, and by estimation to one-fifth of a second. The angles were measured individually and by directions with telescope direct and reversed and on different positions of the circle. The station adjustment was made arbitrarily, the angles being required to agree among themselves and to close the horizon. Figures were adjusted by the method of least squares. All work in connection with this triangulation was done by Mr. A. P. Davis.

DESCRIPTIONS AND POSITIONS OF STATIONS.

WOODSON.

A high, prominent, and very rocky butte in San Diego Co., Cal., 6 miles south of San Pascual Valley, and just west of Woodson's ranch. It is surmounted by a huge granite bowlder, the highest point of which is the station.

Permanent mark: A cairn of stones.

[Latitude, 33° 00′ 25″·1. Longitude, 116° 58′ 17″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Whitney..........	122	51	51·8	302	45	49·4	4·3119354
Burnt.............	157	35	13·1	337	32	05·7	4·3675063
Cuyamaca	281	18	22·6	101	30	16·2	4·5407133
San Miguel	354	42	02·0	174	43	09·0	4·5414240
Cowles............	14	46	27·4	194	44	27·7	4·3515457
Black..............	77	33	36·7	257	28	51·2	4·1442189

CUYAMACA.

Cuyamaca Mountain is the highest mountain in San Diego County. The station is not on the highest point, but is indicated by a large, lone spruce tree east of the summit, which was trimmed up for a signal.

[Latitude, 32° 56′ 42″·2. Longitude, 116° 36′ 26″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Woodson	101	30	16·2	281	18	22·6	4·5407133
Cowles	69	38	51·9	249	25	00·6	4·6282849

SAN MIGUEL.

A high prominent mountain peak, about 12 miles east of San Diego, in San Diego Co., Cal. It is approached from the southwest by a good trail leading to the top. The station is on the highest point.

Permanent mark: A large cairn of stones.

[Latitude, 32° 41′ 41″. Longitude, 116° 56′ 14″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Woodson	174	43	09	354	42	02	4·541424
Cowles	145	19	09	325	16	03	4·196130

COWLES.

The highest of a range of hills 4 miles west of Santee Station, in San Diego Co., Cal., on the Cuyamaca railroad, and south of the San Diego River.

Permanent mark: A cairn of stones on the highest point marks the station.

[Latitude, 32° 48′ 39″·9. Longitude, 117° 01′ 58″·0.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Woodson	194	44	27·7	14	46	27·4	4·3515457
Black..............	157	08	06·4	337	05	21·3	4·3077783
Cuyamaca.........	249	25	00·6	69	38	51·9	4·6282849
San Miguel........	325	16	03·0	145	19	09·0	4·1961300

BLACK.

A prominent hill, 7 miles southwest of Bernardo Post-Office, in San Diego Co., Cal., and the highest point on the Penasquitas ranch.

Permanent mark: A cairn of stones on the highest point.

[Latitude, 32° 58′ 47″·4. Longitude, 117° 07′ 02″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Whitney	165	34	22·7	345	33	06.3	4·1639436
Woodson	257	28	51·2	77	33	36.7	4·1442189
Cowles	337	05	21·3	157	08	06.4	4·3077783

WHITNEY.

A round prominent knoll, the highest peak of a cluster of hills, in San Diego Co., Cal., about 5 miles west of Escondido.

Permanent mark: A cairn of stones on the highest point.

[Latitude, 33° 06′ 25″·9. Longitude, 117° 09′ 22″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kelley	111	15	04·5	291	09	35·6	4·2234196
High Knob	166	44	32·3	346	43	35·2	4·0712031
Burnt	218	34	29·7	38	37	25·4	4·1253160
Woodson	302	45	49·4	122	51	51·8	4·3119354
Black	345	33	06·3	165	34	22·7	4·1639436

BURNT.

A sharp rocky peak, surmounted by a large bowlder, 2½ miles southwest of Valley Center, in San Diego Co., Cal., and 6 miles north of Escondido.

Permanent mark: A cairn of stones on the highest point.

[Latitude, 33° 12′ 04″·4. Longitude, 117° 04′ 00″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
High Knob	95	24	39·0	275	20	45·9	4·0442018
Whitney	38	37	25·4	218	34	29·7	4·1253160
Lancaster	154	07	58·4	334	05	42·6	4·1667805
Roderick	257	10	20·0	77	15	41·5	4·1927250
Centipede	309	04	16·0	129	06	18·0	3·8724820
Woodson	337	32	05·7	157	35	13·1	4·3675063

RODERICK.

A bare, rocky summit, about 10 miles east of Valley Center, in San Diego Co., Cal.

Permanent mark: A granite bowlder, surmounted by a cairn of stones.

[Latitude, 33° 13′ 56″·4. Longitude, 116° 54′ 14″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Lancaster	114	22	56·1	294	15	18·2	4·3747615
Burnt	77	15	41·5	257	10	20·0	4·1927250

HIGH KNOB.

A prominent summit, the highest point of the San Marcos Mountains, in San Diego Co., Cal., 3½ miles nearly east of Vista, a station on the Southern California Railway.

Permanent mark: A cairn of stones on the highest point, with a pol in the center.

[Latitude, 33° 12′ 38″·1. Longitude, 117° 11′ 06″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wire	95	32	48·4	275	26	47·5	4·2339837
Kelley	67	13	57·4	247	09	25·2	4·1453561
Lancaster	200	42	49·9	20	44	27·5	4·1143660
Burnt	275	20	45·9	95	24	39·0	4·0442018
Centipede	288	48	23·0	108	51	18·0	4·2494800
Whitney	346	43	35·2	166	44	32·3	4·0712031

KELLEY.

A station of the U. S. Coast and Geodetic Survey, on top of th ridge back of Carlsbad, in San Diego Co., Cal., 2 miles from the coast It is on a rise slightly higher than the rest of the ridge. A black glas bottle was buried neck up, 20 inches below ground, and the center o its mouth marks the station. A 3 by 4 by 24 inch redwood stub, nai in center of its top, buried 20 inches in ground, is the surface mark.

[Latitude, 33° 09′ 42″·3. Longitude, 117° 19′ 23″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wire	149	21	30·3	329	20	01·8	3·9140790
Mora	197	53	02·6	17	54	46·2	4·2021598
High Knob	247	09	25·2	67	13	57·4	4·1453561
Whitney	291	09	35·6	111	15	04·5	4·2234196

WIRE.

A station of the U. S. Coast and Geodetic Survey, on the Santa Margarita ranch, in San Diego Co., Cal. It is situated on the top of th ridge between the San Luis Rey and the Santa Margarita rivers, abou 2 miles from the coast, and 300 yards north of the wire fence on th ranch line which crosses this ridge. A black glass bottle was burie neck up, with its top 24 inches beneath the surface of the ground, th center of the mouth of the bottle denoting the station. A 3 by 4 b 24 inch redwood stub, buried 24 inches in the ground, is the surfac mark, and a nail driven in the center of the top of this stub marks th station.

[Latitude, 33° 13′ 31″·4. Longitude, 117° 22′ 05″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kelley	329	20	01·8	149	21	30·3	3·9140790
Mora	228	13	20·8	48	16	33·0	4·0850062
High Knob	275	26	47·5	95	32	48·4	4·2339837

MORA.

A round, prominent butte on the northern edge of the San Luis Rey Valley, in San Diego Co., Cal., about 3 miles northeast of the San Luis Rey Mission, and is exactly on the southern line of the Santa Margarita grant.

Permanent mark: A cairn of stones on the highest point.

[Latitude, 33° 17′ 54″·4. Longitude, 117° 16′ 14″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Wire	48	16	33·0	228	13	20·8	4·0850062
Kelley	17	54	46·2	197	53	02·6	4·2021598

CENTIPEDE.

A prominent and very brushy and rocky knoll in San Diego Co., Cal., 5½ miles northeast of Escondido and 2 miles east of the road from Escondido to Valley Center. The station is on the summit of an immense bowlder.

Permanent mark: A small cairn of stones.

[Latitude, 33° 09′ 32″. Longitude, 117° 00′ 18″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
High Knob	108	54	18	288	48	23	4·249480
Burnt	129	06	18	309	04	16	3·872482

LANCASTER.

A prominent, rocky point about 1 mile south of the San Luis Rey River, between that river and Moosa Canyon, in San Diego Co., Cal.

Permanent mark: A cairn of stones on the highest point.

[Latitude, 33° 19′ 13″·2. Longitude, 117° 08′ 08″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
High Knob	20	44	27·5	200	42	49·9	4·1143860
Burnt	334	05	42·6	154	07	58·4	4·1667805
Roderick	294	15	18·2	114	22	56·1	4·3747615

MARGARITA.

The highest point on the Santa Margarita ranch, in San Diego Co., Cal., about 10 miles north of the main ranch house and about the same distance from the coast.

Permanent mark: A cairn of stones on the highest point.

[Latitude, 33° 26′ 34″·5. Longitude, 117° 23″ 30″.0]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Santiago	155	43	39·9	335	38	54·0	4·5103156
Elsinore	194	04	00·2	14	05	34·2	4·2567592
Niguel	103	22	57·9	283	11	35·7	4·5160349
Onofre	47	25	14·6	227	21	47·8	4·1200442

ONOFRE.

This is a summit on the range of hills on the coast between the railway stations San Onofre, in San Diego Co., Cal., and Las Flores, on the Santa Margarita grant. It is the highest point on the coast south of San Pedro, and is about 4 miles north of the Las Flores ranch house.

Permanent mark: A large cairn of stones built on the highest point.

[Latitude, 33° 21′ 44″·8. Longitude, 117° 29′ 45″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Santiago	174	35	12·4	354	33	54·3	4·5866848
Niguel	126	34	19·4	306	26	24·8	4·4421641
Margarita	227	21	47·8	47	25	14·6	4·1200442

NIGUEL.

A station of the U. S. C. & G. S. It is on the highest point of the flat summit of the highest ridge, Orange Co., Cal., between San Juan Capistrano and Aliso Canyon, and is the highest summit overlooking the coast between Aliso Canyon and the Canada Salado.

Permanent mark: A hole drilled in a large stone, buried about 1 foot below surface.

[Latitude, 33° 30′ 39″·3. Longitude, 117° 44′ 06″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Santiago	220	08	02·7	40	14	41·2	4·4587607
San Joaquin	145	07	31·0	325	04	56·2	4·1012967
Margarita	283	11	35·7	103	22	57·9	4·5160349
Onofre	306	26	24·8	126	34	19·4	4·4421641

SAN JOAQUIN.

This station is the highest point of the range of hills on the coast, Orange Co., Cal., on the San Joaquin ranch, and just east of the bay of Newport. It is in plain view from the San Joaquin ranch house, and is crowned with a collection of bowlders that show black from the ranch house. It is about 500 meters east of the Coast Survey station of the same name, which is not so high and does not afford so good a view to the east.

Permanent mark: A large wire nail driven into the rotten rock at the center of station. The stone monument stands directly over the station.

[Latitude, 33° 36′ 15″·4. Longitude, 117° 48′ 46″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
S. E. Base	149	48	09·5	329	43	49·2	4·3801679
San Juan	191	18	21·0	11	20	48·7	4·5419586
Niguel	325	04	56·2	145	07	31·0	4·1012967

SANTIAGO.

The highest peak of the group of mountains lying south of Riverside and South Riverside. It is on the county line between Los Angeles and Riverside counties, and a bowlder marked with lead, which was placed to indicate the county line, marks the station. Of the two highest peaks that surmount the range, Santiago is the higher, the less sharp, and the more southern.

[Latitude, 33° 42′ 32″·4. Longitude, 117° 32′ 07″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
S. E. Base	103	40	31·3	283	26	55·1	4·5899081
San Juan	140	06	15·4	319	59	26·9	4·4683918
Jurupa	193	20	12·0	13	23	16·0	4·5647520
Strawberry	205	28	50·0	25	38	52·0	4·8068850
Potato	212	22	21·0	32	30	17·0	4·6123800
Niguel	40	14	41·2	220	08	02·7	4.4587607
Box Springs	220	03	43·4	40	12	11·7	4·5613244
Zania	227	53	15·0	48	08	55·0	4·7634030
Elsinore	304	03	19·3	124	09	40·2	4·3301272
Margarita	335	88	54·0	155	43	39·9	4·5103156
Onofre	354	33	54·3	174	35	12·4	4·5866848

ELSINORE.

A knoll upon the ridge back of Lake Elsinore, in San Diego Co., Cal., opposite the town of Elsinore, and about 3 miles southwest of the lake. The station is on the highest point of the knoll and is marked by an 8-inch iron bolt, driven in the ground with head 6 inches beneath the surface. A cairn of stones is built over the spot, with a flag pole in the center.

[Latitude, 33° 36′ 03″·1. Longitude, 117° 20′ 39″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Santiago	124	09	40·2	304	03	19·3	4·3301272
Box Springs	188	16	36·5	8	18	42·0	4·6048463
Double Butte	236	30	20·0	56	37	40·0	4·3884170
Margarita	14	05	34·2	194	04	00·2	4·2567592

BOX SPRINGS.

This station is on that spur of the San Jacinto Mountains, in S Bernardino Co., Cal., that lies between the San Timoteo Canyon a the San Jacinto Valley. It extends from the main spur toward Al sandro, and lies about 5 miles northeast of the station of Box Sprin on the Perris branch of the Southern California Railroad. The stati is on an elevation above the rest of the ridge.

Permanent mark: A cairn of stones.

[Latitude, 33° 57′ 36″·1. Longitude, 117° 16′ 54″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Juan	82	58	48·8	262	43	29·3	4·6297259
Santiago	40	12	11·7	220	03	43·4	4·5613244
Double Butte	331	01	45·0	151	07	00·0	4·4787560
Elsinore	8	18	42·0	188	16	36·5	4·6048463

DOUBLE BUTTE.

A small double butte, about 8 miles east of the town of Perris, San Diego Co., Cal. It lies between the railroad and wagon road co necting Perris with San Jacinto. The station is on the highest poi

Permanent mark: A small pile of rocks on a large bowlder.

[Latitude, 33° 43′ 21″. Longitude, 117° 07′ 28″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Elsinore	56	37	40	236	30	20	4·388417
Box Springs	151	07	00	331	01	45	4·478756

ZANJA.

The highest point of the Crafton Hills, San Bernardino Co., about miles southeast of Redlands.

Permanent mark: A cairn of stones.

[Latitude, 34° 03′ 32″. Longitude, 117° 04′ 09″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Santiago	48	08	55	227	53	15	4·763403
Strawberry	141	07	04	321	01	27	4·388602

STRAWBERRY.

An elevation or knoll on the main ridge of the San Bernardi Mountains, in San Bernardino Co., Cal., just above Arrowhead H

Springs, and 3 miles southwest of Little Bear Valley. The knoll has been nearly cleared of timber.

Permanent mark: A lone tree.

[Latitude, 34° 13′ 49″. Longitude, 117° 14′ 10″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Juan	52	54	55	232	38	00	4·765922
Santiago	25	38	52	205	28	50	4·806885
Zanja	321	01	27	141	07	04	4·388602

JURUPA.

The highest point of a range of rocky hills in San Bernardino Co., Cal., about 3 miles southwest of Bloomington, and 6 miles northwest of Riverside.

Permanent mark: A hole drilled in the bowlder on the highest point, and filled with lead. A large cairn of stones is built over the spot.

[Latitude, 34° 01′ 51″·6. Longitude, 117° 26′ 37″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Juan	64	19	58	244	10	03	4·481820
Santiago	13	23	16	193	20	12	4·564752

POTATO.

A prominent butte rising abruptly from its base, in San Bernardino Co., Cal., about 3 miles southeast of Colton.

Permanent mark: A small pile of stones on the highest bowlder on the summit.

[Latitude, 34° 01′ 14″. Longitude, 117° 17′ 52″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Juan	73	41	12	253	26	30	4·628655
Santiago	32	30	17	212	22	21	4·612380

WORKMAN.

The highest point of a cluster of hills in Los Angeles Co., Cal., lying directly between the towns of Whittier and Puente. An indifferent wagon road leads to the summit from Whittier.

Permanent mark: A glass bottle, neck upward, about a foot unde the surface.

[Latitude, 33° 59′ 24″. Longitude, 118° 00′ 14″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Juan	289	22	11	109	31	03	4·414242
Southeast Base	345	43	11	165	45	20	4·357178
Pomona	261	54	40	82	02	08	4·316835

POMONA.

A high, round, prominent hill in Los Angeles Co., Cal., about 4 mile southwest of the town of Pomona.

Permanent mark: A small pile of stones on the highest point.

[Latitude, 34° 00′ 58″. Longitude, 117° 46′ 54″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Juan	341	11	58	161	13	23	4·085854
Workman	82	02	08	261	54	40	4·316835
San Jose	123	33	08	303	30	47	3·889230

SAN JOSE.

The highest point of the San Jose hills, in Los Angeles Co., Ca about 5 miles northeast of the town of Puente. It is a promine and rather sharp point, and is directly in line with the tangent the Southern Pacific Railroad running from Pomona eastward Bloomington.

Permanent mark: A small pile of stones on the highest point.

[Latitude, 34° 03′ 17″. Longitude, 117° 51′ 06″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Juan	326	40	27	146	44	13	4·277008
Pomona	303	30	47	123	33	08	3·889230

RAYMOND.

The tower of the Raymond (Los Angeles Co., Cal.) Hotel, on a h 2 miles southeast of Pasadena.

[Latitude, 34° 07′ 20″. Longitude, 118° 08′ 57″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Cahuenga	95	12	46	275	06	48	4·216838
San Gabriel	198	57	45	18	59	26	4·147545

SOUTHEAST BASE.

In Los Angeles Co., near Los Angeles, Cal., about 100 meters west of the main road from Anaheim to Garden Grove and 1 mile from the last-named place.

Permanent mark: A small hole in the silver core of a copper bolt, set in a granite block, 20 inches square, which is set in the brick foundation of the pier. A tower 14 feet square at base and 40 feet high erected around the brick pier.

[Latitude, 33° 47′ 28″·38. Longitude, 117° 56′ 36″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Los Angeles, N. W. Base	142	37	01·1	322	33	10·8	4·2428968
San Joaquin	329	43	49·2	149	48	09·5	4·3801679
Santiago	283	26	55·1	103	40	31·3	4·5899081
Workman	165	45	20·0	345	43	11·0	4·3571780

PLATEAU REGION OF NEW MEXICO, EASTERN ARIZONA, AND UTAH.

METHODS OF WORK.

This triangulation extends over parts of northern New Mexico and eastern Arizona and southeastern Utah, with a few points reaching into Nevada, California, and Colorado. The work depends on the base line at Fort Wingate, New Mexico, which was measured and expanded in 1881 and 1882, and the triangulation carried forward as required for topographic work until the year 1890.

The base line was measured by Prof. J. Howard Gore in 1881, in the valley of the Rio Puerco, near Fort Wingate, using a 4-meter base bar apparatus designed by the U. S. Coast and Geodetic Survey, and has a length, after all corrections are applied, of 6,721,893 meters. The latitude, longitude, and azimuth of the base were determined in 1883 by Prof. A. H. Thompson, assisted by Arthur P. Davis. A Wurdeman combined zenith telescope and transit was used. Longitude was obtained by exchange of time signals with the observatory of the Washington University at St. Louis, Prof. H. S. Pritchett conducting the observations and exchanges at this place. Latitude was determined by the method of zenith distances.

The final results of these observations gives as the position of the east end of the Wingate base line: Latitude, 35° 30′ 17.″80. Longitude, 108° 30′ 28.″08.

The expansion was made by Prof. Gilbert Thompson, in 1881, and Prof. A. H. Thompson in 1882 and 1883, from the base line, both using a Kubel 10-inch repeating vernier theodolite reading to five seconds. Different stations were used in these separate expansions. Subsequent triangulation was performed with the same instrument by Arthur P. Davis until 1890, when a nonrepeating 8-inch micrometer theodolite was used. In the latter part of the season of 1890 the observations were made by Mr. Fred. J. Knight. All that portion of the triangulation west of the one hundred and twelfth meridian was executed by Mr. H. M. Wilson in 1884, with an 8-inch vernier theodolite reading to ten seconds.

In general, the method adopted for the measurement of angles was that of directions, the aim being to obtain from eight to twelve complete sets, including all visible stations. Readings were made on different parts of the circle and with the telescope in direct and reversed position. Measurements were made of single angles and of combinations, in order to obtain conditions for the adjustment, which was made both of stations and figures, by the method of least squares.

Many of the stations in this triangulation were natural points. Upon these no signals were erected before observing. In other cases, signals, either of stone, brush, or trees, were erected. In all cases permanent marks were left to indicate the exact point sighted.

The triangulation covered and gave control points for topography over an area of, approximately, 94,000 square miles.

A descriptive list of stations follows:

DESCRIPTIONS AND POSITIONS OF STATIONS.

CARRISO.

A low, bare, rounded butte, about 150 or 200 feet above the plain, being the southeastern of two buttes in the northern part of township 22 north, range 28 east, and east of Carriso Creek, New Mexico.

Permanent mark: A stone monument on highest point.

[Latitude, 36° 09′ 12″·68. Longitude, 103° 58′ 35″·88.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Canadian	71	20	46·1	250	59	11·3	4·7645271
Montoya	19	20	07·5	199	13	35·8	4·7047279
Laughlin	160	23	07·9	340	15	41·7	4·7455943
Ocate	86	31	46·4	265	53	25·8	4·9903355

LAUGHLIN.

A bare, rounded peak, not rocky, about 16 miles east of Maxwell station, at head of Tinaja Arroya, in township 28 north, range 26 west, in Colfax Co., N. Mex.

Station on highest point.

[Latitude, 36° 37′ 33″·22. Longitude, 104° 11″ 07″·95.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Canadian	27	00	45·5	206	46	28·6	4·9021113
Carriso	340	15	41·7	160	23	07·9	4·7455943
Ocate	53	24	08·0	232	53	00·3	4·9919418

MONTOYA.

A wooded mesa, about 45 miles east of Watrous, on the north line of the Montoya grant, in San Miguel Co., N. Mex.

Permanent mark: A lone tree on flat, partly cleared summit.

[Latitude, 35° 43′ 20″·95. Longitude, 104° 09′ 43″·34.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Canadian	127	12	39·1	306	57	42·0	4·6828758
Corazon	50	50	54·9	230	36	48·7	4·6747201
Carriso	199	13	35·8	19	20	07·5	4·7047279

CANADIAN.

The highest point of the Cornudo hills in Mora Co., N. Mex. It is a bare, round-topped knoll, 25 miles northeast of Watrous.

Permanent mark: A stone monument on highest point.

[Latitude, 35° 59′ 03″·64. Longitude, 104° 35′ 15″·10.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rincon	74	51	38·4	254	17	41·2	4·9564545
Corazon	358	05	50·0	178	06	35·4	4·7709692
Carriso	250	59	11·8	71	20	46·1	4·7645271
Laughlin	206	46	28·6	27	00	45·5	4·9021113
Montoya	306	57	42·0	127	12	39·1	4·6828758
Ocate	106	14	22·1	285	57	40·1	4·6471564

CORAZON.

A mesa butte in San Miguel Co., N. Mex. About 1,000 feet higher than and 3 miles northeast of the Mexican village of Corazon. The top is flat and has been cleared of timber, leaving a lone tree to mark the station, near north end.

[Latitude, 35° 27′ 09″·82. Longitude, 104° 33′ 57″·39.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rincon	111	36	57·6	291	02	28·2	4·9823850
Aguilar	78	10	56·4	257	56	03·8	4·5990019
Pedernal	55	52	19·6	235	15	05·3	5·0759472
Jospinto No. 2	31	49	28·6	211	36	13·2	4·8221737
Canadian	178	06	35·4	358	05	50·0	4·7709692
Montoya	230	36	48·7	50	50	54·9	4·6747201

OCATE.

An old crater or cinder cone about 12 miles north of Fort Union, Mora Co., N. Mex.

Permanent mark: A monument of rough lava rock on highest point.

[Latitude, 36° 05′ 42″·93. Longitude, 105° 03′ 38″·27.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Rincon	50	51	26·0	230	34	05·5	4·7591135
Canadian	285	57	40·1	106	14	22·1	4·6471564
Carriso	265	53	25·8	86	31	46·4	4·9903355
Laughlin	232	53	00·3	53	24	08·0	4·9919418

AGUILAR.

The mesa Aguilar is a flat-topped mesa butte, 2 miles southwest of the Mexican village of Torres, on Gallinas Creek, about 25 miles southeast of Las Vegas, in San Miguel Co., N. Mex.

Permanent mark: A lone tree on about the highest part.

[Latitude, 35° 22′ 43″·14. Longitude, 104° 59′ 37″·65.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thompson	114	07	09·4	293	38	49·7	4·9063551
Rincon	130	33	24·7	310	13	53·2	4·8233282
Pedernal	45	15	03·4	224	52	37·1	4·9228933
Corazon	257	56	03·8	78	10	56·4	4·5990019
Jospinto No. 2	355	10	43·9	175	12	16·3	4·6851871

JOSPINTO NO. 1.

On a mesa about 12 miles southwest of Las Colonias, San Migue Co., N. Mex.

[Latitude, 34° 56′ 42″. Longitude, 104° 57′ 10″.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pedernal	80	16	44	259	52	50	4·807075
Jospinto No. 2	298	41	20	118	41	27	2·557580

JOSPINTO NO. 2.

The highest point of Jospinto Mesa, about 12 miles southwest of Las Colonias, San Miguel Co., N. Mex, and about one-half mile southeast of Jospinto No. 1.

Permanent mark: A leaning lone tree.

[Latitude, 34° 56′ 36″·8. Longitude, 104° 56′ 57″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Jose	134	16	13·6	313	56	38·4	4·8567790
Pedernal	80	28	53·4	260	05	02·8	4·8090772
Aguilar	175	12	16·3	355	10	43·9	4·6851871
Corazon	211	36	13·2	81	49	28·6	4·8221737
Jospinto No. 1	118	41	27·0	298	41	20·0	2·5575800

JACINTO.

A slight wooded elevation in the plain about 19 miles southwest of Anton Chico and 6 miles south of Cañon Blanca, San Miguel Co., N. Mex.

Permanent mark: A conspicuous lone tree.

[Latitude, 35° 05′ 26″. Longitude, 105° 26′ 59″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bernal	199	13	19	19	17	33	4·528035

PEDERNAL.

A large, lone granite cone, about 60 miles east of Albuquerque. It was used in the Wheeler triangulation.

Permanent mark: A stone monument on highest point.

[Latitude, 34° 50′ 43″·96. Longitude, 105° 38′ 38″·28.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sandia	120	29	58·9	300	02	0·2	4·9334895
Thompson	170	53	58·6	350	48	21·1	4·9682933
Aquilar	224	52	37·1	45	15	03·4	4·9228933
Corazon	235	15	05·3	55	52	19·6	5·0759472
Jospinto No. 1	259	52	50·0	80	16	44·0	4·807075
Rincon	184	35	24·7	4	38	33·7	5·0112350
Jospinto No. 2	260	05	02·8	80	28	53·4	4·8090772

RINCON.

A high knoll on the summit of the Las Vegas Mountains, on the main backbone east of the Pecos River.

Permanent mark: A stone monument on the highest point.

[Latitude, 35° 46′ 03″·1. Longitude, 105° 33′ 11″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sandia	54	29	01·3	233	57	33·6	5·0042487
Baldy	111	23	05·9	291	15	54·9	4·2980256
Thompson	65	25	49·1	245	16	57·0	4·4015151
Pedernal	4	38	33·7	184	35	24·7	5·0112350
Aquilar	310	13	53·2	130	33	24·7	4·8233282
Canadian	254	17	41·2	74	51	38·4	4·9564545
Corazon	291	02	28·2	111	36	57·6	4·9823850
Ocate	230	34	05·5	50	51	26·0	4·7591135

THOMPSON.

The highest peak of the southern group of the Santa Fe Mountains, 8 miles east of the city of Santa Fe.

Permanent mark: A slender balsam tree north of the highest point.

[Latitude, 35° 40′ 22″·07. Longitude, 105° 48′ 22″·89.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sandia	50	44	36·3	230	21	59·4	4·8830092
Jemes	91	50	15·2	271	13	25·8	4·9789888
Aquilar	293	38	49·7	114	07	09·4	4·9063551
Langley	125	36	48·7	305	16	30·6	4·8067770
Pedernal	350	48	21·1	170	53	58·6	4·9682933
Rincon	245	16	57·0	65	25	49·1	4·4015151

BALDY.

A high, round, bald peak in the Santa Fe Mountains, about 15 miles northeast of Santa Fe, N. Mex. It was a triangulation point of the Wheeler Survey.

Permanent mark: A large stone monument on the highest point.

[Latitude, 35° 49′ 57″·54. Longitude, 105° 45′ 27″·91.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sandia	43	54	30·5	223	30	09. 3	4·9622107
Langley	109	08	44·2	288	46	46·4	4·7766344
Rincon	291	15	54·9	111	23	05·9	4·2980256

LANGLEY.

Called Santa Clara by Wheeler Survey. The highest peak of the Tewan Mountains, about 17 miles west of Espanola, a station on the Denver and Rio Grande Railroad, in Rio Arriba Co., N. Mex.

Permanent mark: A large stone monument.

[Latitude, 36° 00′ 27″·96. Longitude, 106° 23′ 03″·31.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Jemes	51	11	47·1	230	55	07·1	4·7409990
Thompson	305	16	30·6	125	36	48·7	4·8067770
Baldy	288	46	46·4	109	08	44·2	4·7766344

SANDIA.

The highest peak of the Sandia Mountains, about 15 miles northeast of Albuquerque, N. Mex.

Permanent mark: A lone tree.

[Latitude, 35° 14′ 07″·33. Longitude, 106° 27′ 22″·03.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Jemes	144	32	54·4	324	18	53·9	4·7979000
Taylor	90	33	25·7	269	53	33·0	5·0206116
Baldy	223	30	09·3	43	54	30·5	4·9622107
Pedernal	300	02	00·2	120	29	58·9	4·9334895
Rincon	233	57	33·6	54	29	01·3	5·0042487
Thompson	230	21	59·4	50	44	36·3	4·8830092

JEMES.

The highest peak of the southern end of the Sierra Nacimiento, about 19 miles northwest of the Pueblo of Jemes, Bernalillo Co., N. Mex.

Permanent mark: A lone pine tree near the highest point.

[Latitude, 35° 41′ 44″·66. Longitude, 106° 51′ 30″·59.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Taylor	53	32	43·5	233	06	37·7	4·9285535
Hosta	84	41	15·2	263	54	38·6	5·0840194
Langley	230	55	07·1	51	11	47·1	4·7409990
Sandia	324	18	53·9	144	32	54·4	4·7979000
Thompson	271	13	25·8	91	50	15·2	4·9789888
Copper	180	31	34·3	00	31	42·4	4·5735262

COPPER,

Otherwise called Copper Mountain, is a small butte on the summit of the Sierra Nacimiento range, about 6 miles east of Copper City, Rio Arriba Co., N. Mex. It is just north of the gap through which flows the ditch that conveys water to Copper City.

Permanent mark: A large lone tree northwest of the highest point.

[Latitude, 36° 01′ 59″·9. Longitude, 106° 51′ 16″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hosta	68	06	43·4	247	19	47·2	5·1158874
Jemes	00	31	42·4	180	31	34·3	4·5735262

WAAS.

A high sharp point on the northern end of the Sierra La Sal, Grand Co., Utah. It is of loose rock from the top to some distance down.. It is the point occupied by the Powell survey, whose monument stands on the highest point. Observations were taken near this monument and reduced to it. Waas is a good natural point.

[Latitude, 38° 32′ 21″·2. Longitude, 109° 13′ 39″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Navajo	41	23	00·0	224	19	53·6	5·3442340

PEALE.

The highest peak of the Sierra La Sal, in Grand Co., Utah. The same point under same name was used in the Hayden triangulation.

Permanent mark: A small stone monument.

[Latitude, 38° 26′ 18″·1. Longitude, 109° 13′ 44″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ute Peak	342	39	53·9	162	56	29·3	5·1274286
Abajo	17	09	56·4	197	01	18·1	4·8422017
Navajo	43	21	12·8	222	20	58·9	5·3275052

ABAJO.

Abajo is the highest point of the Sierra Abajo, in San Juan Co., Utah, and is the same point as occupied by A. D. Wilson of the Hayden survey. It was timbered nearly to the top, the trees showing far above the highest point, but it is now cleared. The highest point was occupied and used.

[Latitude, 37° 50′ 22″·5. Longitude, 109° 27′ 43″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Peale	197	01	18·1	17	09	56·4	4·8422017
Ute Peak	315	22	19·7	135	47	20·1	4·9360333
Pastora	347	09	02·5	167	19	51·7	5·0769876

UTE PEAK.

The highest point of the Sierra El Late, in Montezuma Co., Colo. The top was sparsely timbered, but it is now cleared.

Permanent mark: A stone monument on highest point.

[Latitude, 37° 17′ 03″·0. Longitude, 108° 46′ 42″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pastora	32	12	09·9	211	58	12·5	4·8108075
Abajo	135	47	20·1	315	22	19·7	4·9360333
La Huerfano	318	32	54·6	139	06	30·8	5·1020647
Peale	162	56	29·3	342	39	53·9	5·1274286

NAVAJO.

In San Juan Co., Utah, south of the Colorado River, near Lee's Ferry. It is difficult to approach except from the south. It is heavily timbered, with tall pine and balsam. The station consists of a scaffold, built of five tall trees near the highest point. The instrument was placed on this scaffold, and lanes cut to the points sighted. The signal was seen from Wilson, Oraibe, Calabasa, Sonsala, Pastora, Ute Peak, Abajo, and Peale, the latter being over 140 miles distant. When Navajo was occupied the tallest tree had to be cut off for a support for the theodolite independent of the platform. The instrument was 27 feet above the ground.

[Latitude, 37° 02′ 02″·9. Longitude, 110° 52′ 08″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Waas	224	19	53·6	41	23	00·0	5·3442340
Pastora	279	35	18·1	100	36	43·6	5·1883026
Peale	222	20	58·9	43	21	12·8	5·3275052
Wilson	324	41	48·2	145	07	24·4	5·0465085
Oraibe	353	44	30·2	173	50	02·7	5·1097488
Calabasa	308	16	22·1	128	53	21·0	5·0713882

PASTORA.

The highest point of the Carriso Mountains, in northeastern Apache Co., Ariz. It is a bare rounded knoll and not a natural point.

Permanent mark: A stone monument.

[Latitude, 36° 47′ 25″·1. Longitude, 109° 09′ 52″·8.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Navajo	100	36	43·6	279	35	18·1	5·1883026
Abajo	167	19	51·7	347	09	02·5	5·0769376
Calabasa	52	34	32·4	232	10	27·9	4·8812791
La Huerfano	288	29	43·3	109	16	56·9	5·0962691
Roof Butte				170	04	16·1	4·5703043
Ute Peak	211	58	12·5	32	12	09·9	4·8108075

ROOF BUTTE.

A high butte in the eastern part of the Tunitcha Mountains, in Apache Co., Ariz. The top is nearly flat, several hundred yards across, and is not a natural point.

[Latitude, 36° 27′ 37″·1. Longitude, 109° 05′ 31″·4.]

To station.	Azimuth.			Back azimuth.			Log dist.
	°	′	″	°	′	″	*Meters.*
Pastora	170	04	16·1				4·5703043
Zilh	12	27	29·3	192	21	58·4	4·8141432
Calabasa	81	51	19·4	261	24	47·2	4·8295738
Sonsala	358	06	15·7	178	06	37·8	4·6003783

LA HUERFANA.

The highest point of a group of mesas, about 15 miles south of the San Juan River, San Juan Co., N. Mex. This is by no means a natural point, and the absence of suitable rock renders it impracticable to build a monument.

[Latitude, 36° 25′ 34″·1. Longitude, 107° 50′ 41″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pastora	109	16	56·9	288	29	48·3	5·0962691
Ute Peak	139	06	30·8	318	32	54·6	5·1020647

CALABASA.

Calabasa, in Apache Co., Ariz., is on a slight rise on Calabas mesa, near its edge. It was timbered with cedar and piñon. The timber has been cut, with the exception of one piñon tree near the highest point, which constitutes a part of the station. The instrument was placed over the center. A large red pine stands about 150 feet to the southwest and serves for a witness tree.

[Latitude, 36° 22′ 18″·3. Longitude, 109° 50′ 16″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Navajo	128	53	21·0	308	16	22·1	5·0713882
Pastora	232	10	27·0	52	34	32·4	4·8812791
Roof Butte	261	24	47·2	81	51	19·4	4·8295738
Sonsala	293	29	17·0	113	56	04·5	4·8726795
Wilson	58	19	24·9	238	08	11·9	4·5233561

WILSON.

A high wooded mesa, about 20 miles north of Keam's Canyon, Apache Co., Ariz. The point occupied is marked by a signal built of poles and trees on the highest point. Lanes are cut to all points sighted.

[Latitude, 36° 12′ 48″·3. Longitude, 110° 09′ 13″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Zilh	293	42	16·2	114	14	13·8	4·9506506
Calabasa	238	08	11·9	58	19	24·9	4·5233561
Cottonwood	10	40	44·7	190	35	01·4	4·9014405
Navajo	145	07	24·4	324	41	48·2	5·0465085
Oraibe	53	58	11·0	233	38	25·0	4·7900006

SONSALA.

The eastern of two buttes, and just east of Washington Pass and 25 miles north of Fort Defiance, Apache Co., Ariz. It is not a good natural point. The sides are timbered, but the top is not.

Permanent mark: A stone monument on highest point.

[Latitude, 36° 06′ 05″·2. Longitude, 109° 04′ 41″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
McKenzie	325	03	00·20	145	25	15·4	5·0033911
Calabasa	113	56	04·50	293	29	17·0	4·8726795
Roof Butte	178	06	37·80	358	06	15·7	4·6003783
Chusca	317	46	14·40	137	54	44·1	4·5100664
Zilh	32	50	54·98	212	44	54.5	4·4527421

ZILH.

A small butte standing on Navajo Plateau, in Apache Co., Ariz., 12 miles northwest of Fort Defiance. It was heavily timbered but is now cleared with the exception of a tall pine tree, left for a signal, to which the observations were reduced. It is not a natural point.

[Latitude, 35° 53′ 11″·65. Longitude, 109° 14′ 55″·11.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Sonsala	212	44	54·50	32	50	54·98	4·4527421
Cottonwood	66	47	37·24	246	10	13·88	5·0228907
Chusca	270	06	42·20	90	21	10·10	4·5698015
Iola	35	26	01·20	215	06	27·60	4·7843436
McKenzie	308	41	48·40	120	09	57·40	4·9722791
Roof Butte	192	21	58·40	12	27	29·30	4·8141432
Wilson	114	14	13·80	293	42	16·20	4·9506506

CHUSCA.

Is a sharp peak, on the end of a spur that juts out to the south from the Chusca Plateau, in Bernalillo Co., N. Mex. It is bare and an excellent natural point, affording a good view in all directions except north, where the Chusca Plateau cuts off the view.

[Latitude, 35° 53′ 06″·75. Longitude, 108° 50′ 14″·52.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nell	339	21	40·2	159	29	08·7	4·7410188
Twins	359	40	03·1	179	40	08·9	4·6371148
Zuñi	40	33	18·8	184	30	44·4	4·9280539
McKenzie	328	36	30·1	148	50	16·8	4·8376057
Zilh	90	21	10·1	270	06	42·2	4·5698015
Sonsala	137	54	44·1	317	46	14·4	4·5100664
Crofton	18	13	31·4	198	03	51·7	4·9067286
Square Mesa	325	28	09·2	145	47	36·5	4·9521800
Taylor	302	23	33·0	123	06	24·7	5·1222508
Hosta	299	19	49·5	119	42	27·2	4·8269210

PYRAMID.

A sandstone butte, 7 miles northwest of Fort Wingate, Bernalillo Co., N. Mex., and 1 mile west of the "Navajo church."

Permanent mark: A stone monument on the highest point.

[Latitude, 35° 33′ 18″·80. Longitude, 108° 37′ 01″·12.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
East Base	299	21	41·5	119	25	29·9	4·0555817
Nell	2	17	56·7	182	17	42·9	4·1751919
Twins	71	11	05·8	251	03	30·6	4·3193257

HOSTA.

A flat-topped mesa butte, 13 miles northeast of Coolidge, Bernalillo Co., N. Mex.

Permanent mark: A large pine tree with trunk trimmed and heavy foliage in top.

[Latitude, 35° 35′ 13″·5. Longitude, 108° 11′ 29″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Square Mesa	11	06	11·9	191	03	08·2	4·6194709
Taylor	305	54	10·6	126	14	27·9	4·8167308
Jemes	263	54	38·6	84	41	15·2	5·0840194
Copper	247	19	47·2	68	06	43·4	5·1158874
Chusca	119	42	27·2	299	10	49·5	4·8269210

TWINS.

The eastern of two symmetrical cones, joined at the base, 6 miles southwest of Gallup, Bernalillo Co., N. Mex.

Permanent mark: A stone monument on the summit.

[Latitude, 35° 29′ 39″·79. Longitude, 108° 50′ 04″·54.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pyramid	251	03	30·6	71	11	05·8	4·3193257
Nell	293	07	57·8	113	15	18·5	4·3188760
Chusca	179	40	08·9	359	40	03·1	4·6371148

NELL.

A rocky peak on a monoclinal ridge, 6 miles southwest of Fort Wingate, Bernalillo Co., N. Mex.

Permanent mark: A small stone monument.

[Latitude, 35° 25′ 13″·47. Longitude, 108° 37′ 24″·92.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
West base	199	49	31·70	19	51	12·78	4·1118837
East base	228	13	24·91	48	17	26·75	4·1488124
Chusca	159	29	08·70	339	21	40·20	4·7410188
Zuñi	38	34	54·70	218	24	66·90	4·6236305
Twins	113	15	18·50	293	07	57·80	4·3188760
Pyramid	182	17	42·90	2	17	56·70	4·1751919

WEST BASE.

This station is situated near the foot of some low cliffs about 2 miles northwest from Wingate Station, in Valencia Co., N. Mex.

Permanent mark: A stone post set firmly in the ground. A cross on the upper surface marks the end of the base line and the position of the theodolite in observing angles. Witness stones are placed in the form of a square about the stone, and the intersection of the diagonals of the square marks the position of the stone post indicating the end of the base line.

[Latitude, 35° 31′ 48″·38. Longitude, 108° 34′ 30″·74.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nell	19	51	12·78	199	49	31·70	4·1118837
East base	294	31	11·17	114	33	32·15	3·8274916

EAST BASE.

This station is on a low knoll in Valencia Co., N. Mex., about 2 miles east of the astronomical pier at Wingate Station, N. Mex.

Permanent mark: A stone post set firmly in the ground. A cross cut in the upper surface marks the exact point of the base line and the position of the theodolite in observing angles. The azimuth of the base line was determined by observations at this station on Polaris. Four witness stones were set in the form of a square about the stone post marking this station. The intersection of the diagonals of this square mark the position of the cross on the upper surface of the post.

[Latitude, 35° 30′ 17″·80. Longitude, 108° 30′ 28″·08.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
West base	114	33	32·15	294	31	11·17	3·8274916
Nell	48	17	26·75	228	13	24·91	4·1488124
Pyramid	119	25	29·91	299	21	41·50	4·0555817

ASTRONOMICAL PIER.

The position of the astronomical pier from which the latitude and longitude of the Fort Wingate base was determined is 105 feet northeast from ticket office at Wingate, N. Mex. It was marked by a limestone post set firmly in the ground. A cross was cut on the upper face of the stone to indicate the exact position of the instrument. Longitude of the pier was determined by exchange of time signals for 5 nights with the observatory of the Washington University at St. Louis, Mo. Latitude by observations made on 22 pairs of stars.

Latitude, 35° 30′ 51″·38. Longitude, 108° 32′ 27″·32.

McKENZIE.

Situated on a wooded ridge about 8 miles east of Fort Wingate, Valencia Co., N. Mex. The station is a scaffold about 40 feet high and the instrument was placed part way up. An enormous amount of chopping has been done here from time to time, and this station has been a source of great annoyance on account of the difficulty of finding the signal, at long distances, among the trees. On this account it was abandoned in extending the triangulation and Square Mesa substituted in its place.

[Latitude, 35° 21′ 18″·7. Longitude, 108° 26′ 35″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Zuñi	59	04	24·9	238	48	12·5	4·6967127
Zilh	129	09	57·4	308	41	48·4	4·9722791
Chusca	148	50	16·8	328	36	30·1	4·8376057
Sonsala	145	25	15·4	325	03	00·2	5·0033911
Taylor				99	52	07·0	4·8866779

TAYLOR.

The highest point of the San Mateo Mountains, a high volcanic mountain mass in Valencia Co., N. Mex. The northern slope was timbered and is partly cleared. The highest point was occupied and used, and is marked by a tripod signal. It is the same point published by the Wheeler survey.

[Latitude, 35° 14′ 30″·7. Longitude, 107° 36′ 29″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chusca	123	06	24·7	302	23	33·0	5·1222508
McKenzie	99	52	07·0				4·8866779
Square Mesa	88	05	10·1	267	41	55·4	4·7866140
Hosta	126	14	27·9	305	54	10·6	4·8167308
Jemes	233	06	37·7	53	32	43·5	4·9285635
Pinon	84	25	07·8	218	55	50·8	5·1459548
Sandia	269	53	33·0	90	33	25·7	5·0206116

CROFTON.

A rise on a ridge originally covered by a thick growth of cedars, and situated 6 miles east of south of Allantown, Apache Co., Ariz. It has been cleared, and a signal built of cedar poles with brush in the top. The center of the station is marked by a large nail driven in a cedar bough projecting from the parent stump near the ground.

[Latitude, 35° 11′ 39″·36. Longitude, 109° 06′ 51″·84.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Iola	119	52	13·1	299	34	07·0	4·7375673
Pinon	331	30	29·0	151	52	40·8	5·0989330
Ords Peak	18	01	11·2	197	44	30·3	5·1656953
Hasseltine	53	12	06·1	233	00	41·3	4·5766780
Chusca	198	03	51·7	18	13	31·4	4·9067286
Douglas	86	23	30·5	265	57	10·4	4·8424105
Square Mesa	267	42	22·7	88	11	15·1	4·8811374
Zuñi	292	48	13·2	112	55	14·4	4·3030530

ZUÑI.

The smaller and southeastern of two buttes, northwest of Zuñi Town. Valencia Co., N. Mex.; accessible only from the west.

Permanent mark: A stone monument.

[Latitude, 35° 07′ 25″·93. Longitude, 108° 54′ 40″·29.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nell	218	24	56·9	38	34	54·7	4·6236305
Crofton	112	55	14·4	292	48	13·2	4·3030530
Chusca	184	30	44·4	4	33	18·8	4·9280539
McKenzie	238	48	12·5	59	05	24·9	4·6967127

SQUARE MESA.

A high, timbered "square mesa" in the Zuñi Mountains, Valencia Co., N. Mex., and 13 miles south of Chaves. Lanes were cut to the points sighted, and observations were taken from a scaffold and reduced to the mark.

Permanent mark: A very tall tree trimmed up to about 12 feet from the top.

[Latitude, 35° 13′ 07″·7. Longitude, 108° 16′ 46″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Crofton	88	11	15·1	267	42	22·7	4·8811374
Chusca	145	47	36·5	325	28	09·2	4·9521800
Hosta	191	03	08·2	11	06	11·9	4·6194709
Pinon	8	33	02·9	188	26	44·1	5·0589954
Taylor	267	41	55·4	88	05	10·1	4·7866140

PINON.

The highest peak of the Datil Range, in Socorro Co., N. Mex. It was sparsely timbered on top and has been cleared, leaving a small signal tree near the top. Observations were taken at the highest point and were reduced to the tree. Some of the trees growing on the side are about as high as the top of the mountain, and might be mistaken for the highest point from some directions. The mountain is easiest climbed from the southeast. It was published by Wheeler's survey under the name of Alamocita.

[Latitude, 34° 11′ 51″·1 Longitude, 108° 27′ 52″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Square Mesa	188	26	44·1	8	33	02·9	5·0589954
Taylor	213	55	50·8	34	25	07·8	5·1450548
Crofton	151	52	46·8	331	30	29·0	5·0989330
Ords Peak	75	00	27·5	254	22	08·7	5·0378288
Tularosa	10	11	31·6	190	07	46·8	4·7681763

TULAROSA.

In Socono Co., N. Mex., about 20 miles south of old Fort Tularosa. The same point was occupied by Wheeler survey under the name of Eagle Peak.

Permanent mark: A stone monument on the highest point of the mountain.

[Latitude, 33° 40′ 37″·7. Longitude, 108° 34′ 34″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ords Peak	107	10	40 ·2	286	36	20 ·9	4 ·9977404
Pinon	190	07	46 ·8	10	11	31 ·6	4 ·7681763
Graham	48	29	12 ·1	227	46	41 ·8	5 ·2096385

ORDS PEAK,

Otherwise known as Baldy, is a high, bald knob in the White Mountains, Ariz. Thomas Peak to the east is higher and a better natural point, but affords no view to the west which is cut off by Ords Peak, and for this reason the latter was used as the triangulation point.

Permanent mark: A stone monument 16 feet high and 10 feet in diameter at the base on the highest point.

[Latitude, 33° 56′ 16″·0. Longitude, 109° 36′ 15″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Browns Peak	80	28	42 ·2	259	31	15 ·5	5 ·2088659
San Francisco	130	00	48 ·4	308	50	07 ·1	5 ·3909744
Piñon	254	22	08 ·7	75	00	27 ·5	5 ·0378288
Tularosa	286	36	20 ·9	107	10	40 ·2	4 ·9977404
Crofton	197	44	30 ·3	18	01	11 ·2	5 ·1656953
Douglas	169	34	44 ·7	349	25	31 ·3	5 ·1368081
Graham	10	18	59 ·9	190	10	13 ·9	5 ·1438981
Mazatzal	95	08	17 ·8	274	06	00 ·6	5 ·2356658

GRAHAM.

Highest point of Graham Mountain, south of the Gila River, near Solomonsville, Graham Co., Ariz. The mountain is heavily timbered, and lanes are cut to Piñon Mountain, Ords Peak, and Browns Peak.

Permanent mark: A small clump of very tall trees, growing close together.

[Latitude, 32° 42′ 07″·0. Longitude, 109° 52′ 13″·4.]

To station.	Azimuth.			Back azimuth			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ords Peak	190	10	13 ·9	10	18	59 ·9	5 ·1438981
Tularosa	227	46	41 ·8	48	29	12 ·1	5 ·2096385
Browns Peak	129	10	31 ·6	308	22	44 ·7	5 ·2405049

BROWNS PEAK.

The highest and most northern of the "Four Peaks," west of Tonto Basin, Ariz. It is very difficult to climb, bare on top, and a fair natural point.

Permanent mark: A stone monument on the highest point.

[Latitude, 33° 41′ 04″ ·2. Longitude, 111° 19′ 29″ ·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Graham	308	22	44·7	129	10	31·6	5·2405049
San Francisco....	170	09	50·6	349	56	54·1	5·2722252
Mazatzal	163	22	45.7	343	17	13·2	4·6413886
Ords Peak........	259	31	15·5	80	28	42·2	5·2088659

MAZATZAL.

The highest point of the northern group of the Mazatzal Mountains west of Tonto Basin, Yavapai Co., Ariz. The point is best approached by climbing the long ridge reaching down to the east.

Permanent mark: A small pile of stones.

[Latitude, 34° 03′ 45″ ·7. Longitude, 111° 27′ 38″ ·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Browns Peak	343	17	13·2	163	22	45·7	4·6413886
Granite...........	122	43	59·9	302	07	02·5	5·0754858
Ords Peak.........	274	06	00·6	95	08	17·8	5·2356658
San Francisco....	172	56	41·9	352	00	38·4	5·1576796
Bakers Butte.....	190	00	56·1	10	03	44·4	4·6422243

BAKERS BUTTE.

Is a knoll on the edge of the Mogollon mesa, above Tonto Basin, about 8 miles west of the "Tunnel," in Yavapai Co., Ariz. It was heavily timbered, but has been cleared, except a large pine tree near the top, to which observations were reduced. The "Potato Ranch," a mile to the north, is a convenient and excellent camp from which to visit the butte.

[Latitude, 34° 27′ 08″ ·6. Longitude, 111° 22′ 39″.6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Francisco	164	39	15·4	344	28	58·5	5·0123560
Mazatzal	10	03	44·4	190	00	56·1	4·6422243
Granite............	101	08	50·0	280	28	52·9	5·0404877
Del Pasco..........	75	24	21·0	....	....	....	4·974008
Chevlon............	241	06	48·0	61	24	50·4	4·7439038
Sunset.............	217	11	21·6	37	25	35·0	4·7903065

CHEVLON.

Is a large, flat-topped, timbered butte about 30 miles south of Winslow, Apache Co., Ariz. The horizon from south around by the west to the northeast is commanded, but the east and southeast are cut off by the timber.

Permanent mark: A lone tree near the northeast end of summit.

[Latitude, 34° 41′ 33″·8. Longitude, 110° 50′ 52″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Bakers Butte.....	61	24	50·4	241	06	48·0	4·7439038
San Francisco	134	00	32·2	306	43	39·8	5·0204678
Douglas...........	239	49	38·9	60	28	29·5	5·0096390
Sunset............	156	11	11·5	336	07	18·9	4·4088258

SUNSET.

The knoll on the mesa that forms the western wall of Sunset Pass, 18 miles southwest of Winslow, Yavapai Co., Ariz. It is a fair, natural point.

Permanent mark: A stone monument on the highest point.

[Latitude, 34° 54′ 14″·7. Longitude, 110° 57′ 39″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Chevlon	326	07	18·9	156	11	11·5	4·4088258
Bakers Butte....	37	25	35·0	217	11	21·6	4·7993665
Cottonwood.......	221	03	26·5	41	25	43·8	4·9494990
Douglas	254	08	15·2	74	45	36·4	5·0117591
San Francisco....	127	08	23·0	306	43	39·7	4·9120243
Woodruff Butte ..	277	37	30·4	98	09	01·2	4·9280824

WOODRUFF BUTTE.

A sharp lava cone near the town of Woodruff, Ariz., occupied as a secondary station.

Permanent mark: A stone monument on the highest point.

[Latitude, 34° 47′ 56″·7. Longitude, 110° 02′ 31″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Douglas	201	02	55·7	21	08	37·4	4·6233254
Hasseltine........	248	36	03·1	68	56	32·0	4·7672366
Sunset............	98	09	01·2	277	37	30·4	4·9280824

HASSELTINE.

A slight elevation on the wooded ridge trending in an east and west direction, about 8 miles south of Navajo Springs, Apache Co., Ariz. It is about one-half mile west of where the road from Navajo to St.

Johns climbs the ridge. The point is marked by two trees standing close together, the vicinity having been cleared. The instrument was placed on the highest point, and the observations reduced to the signal. This station is hard to find, and is not used in the main scheme of triangulation.

[Latitude, 34° 59′ 24″·3. Longitude, 109° 26′ 43″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Douglas	114	43	38 ·5	294	28	46 ·8	4 ·6359622
Iola	160	47	08 ·0	340	40	31 ·5	4 ·7217592
Crofton	233	00	41 ·3	53	12	06 ·1	4 ·5766780
Woodruff Butte	68	56	32 ·0	248	36	03 ·1	4 ·7672366

DOUGLAS.

A large, prominent butte, about 12 miles north of Carrizo, Apache Co., Ariz. It is of lava, and stands perhaps 600 feet above the base.

Permanent mark: A stone monument on the highest point.

[Latitude, 35° 09′ 08″·6. Longitude, 109° 52′ 35″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Crofton	265	57	10 ·4	86	23	30 ·5	4 ·8424105
Sunset	74	45	36 ·4	254	08	15 ·2	5 ·0117591
Chevlon	60	23	29 ·5	239	49	38 ·9	5 ·0090390
Ords Peak	349	25	31 ·3	169	34	44 ·7	5 ·1368081
San Francisco	98	00	03 ·5	276	57	42 ·2	5 ·2182681
Hasseltine	294	28	46 ·8	114	43	38 ·5	4 ·6359622
Iola	214	28	01 ·0	34	36	20 ·5	4 ·5857480
Woodruff Butte	21	08	37 ·4	201	02	55 ·7	4 ·6233254

IOLA.

Situated on a sand ridge, about 9 miles northeast of Tanners Springs, Apache Co., Ariz. A lone piñon tree serves as a signal, and a nail driven in a low horizontal branch marks the center of the station.

[Latitude, 35° 26′ 18″·4. Longitude, 109° 38′ 10″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Zilh	215	06	27 ·6	35	20	01 ·2	4 ·7843436
Cottonwood	97	15	55 ·8	276	52	14 ·6	4 ·7938988
Douglas	34	36	20 ·5	214	28	01 ·0	4 ·5857480
Crofton	299	34	07 ·0	119	52	13 ·1	4 ·7875673
Hasseltine	340	40	31.5	160	47	08 ·0	4.7217592

COTTONWOOD.

Is a small knoll, in Apache Co., Ariz., on the mesa, about 30 miles north of Holbrook, in which Cottonwood Spring is situated. It is difficult to recognize, and is not a good natural point.

Permanent mark: A stone monument.

[Latitude, 35° 30′ 26″·8. Longitude, 110° 18′ 59″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Oraibe	139	09	30·4	318	55	36·3	4·7390394
Sunset	41	25	43·8	221	03	26·5	4·9494990
San Francisco	82	09	59·9	261	22	41·3	5·0963786
Wilson	190	35	01·4	10	40	44·7	4·9014405
Iola	276	52	14·6	97	15	55·8	4·7938988
Zilh	246	10	13·9	66	47	37·2	5·0228907

ORAIBE.

A butte (Apache Co., Ariz.) on the end of a spur reaching to the south from the long mesa on which the Moqui towns are built. It is about 6 miles west of Oraibe village.

Permanent mark: A stone monument.

[Latitude, 35° 52′ 50″·4. Longitude, 110° 42′ 49″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Navajo	173	50	02·7	353	44	30·2	5·1097488
Wilson	233	38	25·0	53	58	11·0	4·7960006
Cottonwood	318	55	36·3	139	09	30·4	4·7890394

SAN FRANCISCO.

A well-known volcanic mountain, standing on the Colorado Plateau, in Coconino Co., Ariz.

Permanent mark: A stone cairn 10 feet high.

[Latitude, 35° 20′ 47″·0. Longitude, 111° 40′ 37″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ords Peak	308	50	07·1	130	00	48·4	5·3909744
Cottonwood	261	22	41·3	82	09	59·9	5·0963786
Douglas	276	57	42·2	98	00	03·5	5·2182681
Chevlon	306	43	39·8	134	00	32·2	5·0204678
Bakers Butte	344	28	58·5	164	39	15·4	5·0123560
Mazatzal	352	00	38·4	172	56	41·9	5·1576253
Browns Peak	349	56	54·1	170	09	50·6	5·2722252
Granite	45	43	39·8	225	13	33·2	5·0494630
Floyd	93	23	34·4	272	47	14·3	4·9787020
Sunset	306	43	39·7	127	08	23·0	4·9120243

GRANITE.

A sharp, rocky peak, 8 miles northwest of Prescott, Yavapai, Co., Ariz. It is difficult to climb, being most easily accessible from the northwest. It is a good natural point, being rather sharp, and sur-

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mounted by a large bowlder. The observations were taken near this bowlder and reduced to its center.

[Latitude, 34° 38′ 17″·0. Longitude, 112° 33′ 08″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
San Francisco	225	13	33·2	45	43	39·8	5·0494630
Bakers Butte	280	28	52·9	101	08	50·8	5·0404877
Floyd.............	169	28	59·7	349	23	06·3	4·9302200
Aquarius..........	117	02	10·3	296	36	39·5	4·8832267
Mazatzal	302	07	02 5	122	43	59·9	5·0754858

BILL WILLIAMS.

A good natural point; the highest point of Bill Williams Mountain, about 5 miles south of Williams, a station on the Atlantic and Pacific Railroad, in Yavapai Co., Ariz.

Permanent mark: A cairn of stones.

[Latitude, 35° 11′ 59″·6. Longitude, 112° 12′ 15″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Floyd.............	114	31	04·3	294	13	04·6	4·7146148
Aquarius..........	74	42	51·4	254	05	09·9	5·0150355

FLOYD.

A sharp peak, about 8 miles north of Crookton, Yavapai Co., Ariz.

Permanent mark: A stone monument 12 feet high and 10 feet in diameter, built by the Powell Survey.

[Latitude, 35° 23′ 33″·6. Longitude, 112° 43′ 24″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Aquarius..........	46	54	04·0	226	34	13·5	4·8562771
San Francisco	272	47	14·3	93	23	34·4	4·9787020
Granite...........	349	23	06·3	169	28	59·7	4·9302200
Hualapai	72	04	56·8	251	24	19·9	5·0510471
Tipton...	97	21	59·8	276	30	52·6	5·1279544
Emma..............	157	27	56·7	337	12	15·2	5·0202043
Bill Williams.....	294	13	04·6	114	31	04·3	4.7146148

AQUARIUS.

Highest point of Aquarius Mountain, in Yavapai Co., Ariz., about 25 miles south of Peach Spring.

Permanent mark: A cairn of rocks 8 feet high.

[Latitude, 34° 56′ 56″·2. Longitude, 113° 17′ 51″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Granite...........	296	36	39·5	117	02	10·3	4·8832267
Floyd.............	226	34	13·5	46	54	04·0	4·8562771
Hualapai	104	31	14·8	284	10	37·0	4·7517284
Bill Williams.....	254	05	09·9	74	42	51·4	5·0150355

HUALAPAI.

In Mohave Co., Ariz., on highest point of Hualapai Mountain, 8 miles south of Kingman.

Permanent mark: Two large rocks on summit.

[Latitude, 35° 04′ 30″·2. Longitude, 113° 53′ 48″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Floyd	251	24	19·9	72	04	56·8	5·0510471
Aquarius	284	10	37·0	104	31	14·8	4·7517284
Emma	206	17	47·4	26	43	12·9	5·1685025

EMMA.

The highest southerly peak of the Uinkaret Mountains, in Mohave Co., Ariz., about 7 miles north of the Colorado River, on the brink of the Grand Canyon, and 10 miles south of Trumbull Spring.

Permanent mark: A stone monument.

[Latitude, 36° 15′ 50″·2. Longitude, 113° 10′ 12″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Brink	254	07	01·4	74	33	44·8	4·8453629
Floyd	337	12	15·2	157	27	56·7	5·0202043
Hualapai	26	43	12·9	206	17	47·4	5·1685025
Tipton	49	12	09·4	228	36	12·8	5·0877102
Virgin	114	17	40·3	293	44	09·1	4·9654204

TIPTON.

In Mohave Co., Ariz., on highest point of Mount Tipton, 6 miles north of Mineral Park.

Permanent mark: Large pine tree on summit of peak.

[Latitude, 35° 32′ 21″·1. Longitude, 114° 11′ 30″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Charleston	121	22	54·8	300	30	02·9	5·1989854
Emma	228	36	12·8	49	12	09·4	5·0877102
Floyd	276	30	52·6	97	21	59·8	5·1279543
Virgin	183	30	28·7	3	33	20·2	5·0728221
Dead Man	58	53	00·0	238	34	33·3	4·7512024
Muddy	150	59	22·7	330	41	02·1	4·9846258

VIRGIN.

The highest peak of the Virgin Mountains, 16 miles northeast of St. Thomas, Lincoln Co., Nev. This station was formerly occupied by the Powell Survey.

[Latitude, 36° 36′ 09″·6. Latitude, 114° 06′ 39″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tipton	3	33	20·2	183	30	28·7	5·0728221
Emma	293	44	09·1	114	17	40·3	4·9654204
Dead Man	20	42	53.8	200	21	21.7	5.1967178
Charleston	75	57	55·9	255	01	30·6	5·1662178

DEAD MAN.

The highest point of Dead Mountain, in Lincoln Co., Nev., 16 miles north and a little west of Camp Mojave, and 8 miles west of the Colorado River. Station is on the highest point of rocks at extreme northwest end of peak, which is not a good natural point.

Permanent mark: A stone monument.

[Latitude, 35° 16′ 30″·3. Longitude, 114° 43′ 20″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Virgin	200	21	21·7	20	42	53·8	5·1967173
Tipton	238	34	33·3	58	53	00·0	4·7512024
Muddy	180	25	48·9	360	26	08·9	5·0552302

MUDDY.

Highest point of Muddy Mountains, 24 miles southwest of St. Thomas, Lincoln Co., Nev. Peak is a good natural point.

[Latitude, 36° 17′ 54″·8. Longitude, 114° 42′ 46″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Dead Man	360	26	08·9	180	25	48·9	5·0552302
Tipton	330	41	02·1	150	59	22·7	4·9846258

CHARLESTON.

In Lincoln, Nev., on highest peak of Timber Mountain, 15 miles southwest of Los Vegas, Nev. Signal is natural point of rocks.

[Latitude, 36° 16′ 18″·0 Longitude, 115° 41′ 38″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Tipton	300	30	02·9	121	22	54·8	5·1989854
Virgin	255	01	30·6	75	57	55·9	5·1662173

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TRIANGULATION OF THE POWELL SURVEY.

METHODS OF WORK.

The triangulation in this State was developed from two base lines, the first being measured at Kanab, Utah, and the second at Gunnison, in the same State. These base lines are 150 miles apart, the Gunnison line being the more northern and eastern. The Kanab base was first located and measured under direction of Prof. A. H. Thompson, in the winter of 1871–'72. Trussed wooden bars, supported upon adjustable trestles, were used. These bars were oiled and varnished to prevent absorption of moisture and tested by comparison with a standard steel tape, whose length and coefficient of temperature were known.

In the fall of 1878 a portion of this base line was remeasured under direction of Prof. G. K. Gilbert, with the apparatus used in the measurement of the Gunnison base line, and the result of this latter measurement adopted as the length of the Kanab base. The ends of the base line were marked by stone posts of basalt set firmly in the ground, the ends of the line being marked by a cut in the upper surface of the posts.

The latitude and longitude of the Kanab base line were determined by Prof. A. H. Thompson, in 1872. For longitude, time signals were exchanged with the astronomical observatory of the Deseret University at Salt Lake City, Mr. E. P. Austin, astronomer of the U. S. Engineers Geographical Survey west of the one hundredth meridian, whose services were kindly tendered by Lieut. Geo. M. Wheeler, in charge of that organization, conducting the observations and exchanges at that place.

Latitude was determined by the Talcott method of zenith distances, the instrument used being a combined transit and zenith telescope. Azimuth was determined by observations on Polaris.

The final adjusted results of these observations gives, as the position of the north end of the Kanab base line, longitude 112° 31′ 21″·42 W., latitude 36° 57′ 46″·54 N.

The Gunnison base line was measured under the direction of Prof. A. H. Thompson, in 1875, the measurement being made by wooden rods carried in a trussed wooden case. These rods were oiled and varnished to prevent absorption of moisture, and their length was carefully determined by comparisons with standard steel rods furnished by the U. S. Coast and Geodetic Survey.

The Gunnison base line was located in the meridian of the astronomical station at Gunnison, determined in 1872 by the U. S. engineers' survey west of the one hundredth meridian, and the longitude of their monument adopted as the longitude of the north end of the base line. Its latitude was determined from observations of zenith distances by Prof. A. H. Thompson, in 1874. The adopted position of the north end of the base line is latitude 39° 08′ 28″·30 N., longitude 111° 49′ 16″·23 W. Both ends of this base are marked by a cross on the upper surface of a stone post set firmly in the ground.

The Gunnison and Kanab bases were connected by triangulation, the angles being measured by a theodolite having a 10-inch circle and reading by two verniers to 5 seconds. This triangulation was adjusted by the method of least squares, and the result, giving for the Gunnison base a length of 32,182.39 feet, and for the Kanab base a length of 22,619.73 feet, adopted for the computation of the latitudes and longitudes of the triangulation stations in Utah and northwestern Arizona.

Signals were erected on all triangulation stations, which were not good natural points, before the angles were observed.

The method adopted for observations of angles was usually by directions and on different parts of the circle. These angles were then repeated with the telescope in reversed position. From three to eight sets of these observations were made. After making an arbitrary station adjustment, all figures were adjusted by the method of least squares.

This system of triangulation covered and gave control points for topography over an area of approximately 108,000 square miles. Following is a descriptive list of triangulation stations, giving latitude and longitude of each station, together with azimuth and distances to such other stations as were used in the adjustment of figures.

DESCRIPTIONS AND POSITIONS OF STATIONS.

SPANISH FORK.

A well-defined and well-known peak of the Wasatch Range, in Utah Co., Utah, seven miles east of the village of Spanish Fork.

Permanent mark: A small cairn of stone.

[Latitude, 40° 05′ 18″·5. Longitude, 111° 31′ 40″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nebo	33	35	57	213	26	45	4·5672955
Indian Head	294	25	25	114	49	59	4·7773526
Bruin	295	38	14	116	23	34	5·0501985
South Tent	349	15	10	169	21	41	4·8954328

NEBO.

The most southerly high peak of the Wasatch Mountains in Juab Co., Utah. The summit shows three sharp points of nearly the same altitude, and the station was made upon the one farthest south. It is 8 miles north-northeast from the town of Nephi and 4½ miles east from Mona.

Permanent mark: A cairn 7 feet high.

[Latitude, 39° 48′ 35″·4. Longitude, 111° 45′ 59″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Katharine	19	39	31	199	25	18	4·9832646
Canyon Range	39	21	02	219	04	10	4·7778485
Spanish Fork	213	26	45	33	35	57	4·5672965
Indian Head	265	16	45	85	50	25	4·8762365
Bruin	278	10	52	99	05	14	5·0896693
South Tent	322	47	26	143	03	04	4·7651455
Musinia	349	14	31	169	21	41	4·9418712
Hilgard	351	11	37	171	20	05	5·1021473
Ephraim	358	26	11	178	26	46	4·6881882

INDIAN HEAD.

A rounded summit of the west Tavaputs Plateau, north of Emma Park, in Utah Co., Utah. It is the highest point in the vicinity.

Permanent mark: A 5-foot cairn of rocks.

[Latitude, 39° 51′ 44″·2. Longitude, 110° 58′ 26″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
South Tent	37	38	48	217	20	55	4·8188338
Nebo	85	50	25	265	16	45	4·8762365
Spanish Fork	114	49	59	294	25	25	4·7773526
Bruin	297	26	01	117	46	48	4·7192701
Red Plateau	343	01	56	163	12	17	4·9044670

BRUIN.

A summit of the west Tavaputs Plateau, Emery Co., Utah, 17 miles est from the Green River. It is the highest point of the vicinity.

Permanent mark: A cairn 5 feet high.

[Latitude, 39° 38′ 37″·1. Longitude, 110° 20′ 56″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ellen	13	35	55	193	18	21	5·2401173
Red Plateau	24	01	37	203	51	19	4·7593733
Hilgard	44	28	34	223	43	19	5·1714955
Bare Brush	52	44	14	232	07	38	5·0195761
South Tent	72	26	06	251	47	36	4·9598218
Nebo	99	05	14	278	10	52	5·0896693
Spanish Fork	116	23	34	295	38	14	5·0501985
Indian Head	117	46	48	297	26	01	4·7192701
Waas	321	19	28	142	01	53	5·1941553

CANYON RANGE.

The mountain range through which the Sevier River cuts in its lower urse bears a number of sharp peaks in Millard Co., Utah. The one selected stands about midway between the canyon of the Sevier and the town of Scipio. It was not occupied, but was sighted from a number of stations at the east.

[Latitude, 39° 23′ 30″·7. Longitude, 112′ 12′ 26·″5.]

Station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Nebo	219	04	10	39	21	02	4·7773485
South Tent	269	46	16	90	18	37	4·8644279
Ephraim	270	05	04	90	22	26	4·5937830
Musinia	305	50	21	126	14	13	4·8274974
Katharine	352	30	28	172	33	13	4·6498542

EPHRAIM.

A flat-topped summit of the Gunnison Plateau, in Sanpete Co., Utah, 9 miles west-northwest from the town of Ephraim.

Permanent mark: A cairn 5 feet high.

[Latitude, 39° 23′ 25″·6. Longitude, 111° 45′ 06″·6.]

Station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Katharine	37	22	37	217	07	53	4·7437159
Canyon Range	90	22	26	270	05	04	4·5937830
Nebo	178	26	46	358	26	11	4·6681882
South Tent	269	41	51	89	56	51	4·5307425
Musinia	339	04	58	159	11	33	4·6248411
Hilgard	347	01	18	167	09	09	4·9059241

SOUTH TENT.

A summit of the Wasatch Plateau, in Sanpete Co., Utah, 10 miles southeast from Springtown. There is no well-defined point, but a rounded profile is seen from most directions.

Permanent mark: A cairn 5 feet high.

[Latitude, 39° 23′ 29″·1. Longitude, 111° 21′ 28″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hilgard	11	38	54	191	31	53	4·9043279
Musinia	25	46	45	205	38	23	4·6418233
Katharine	57	03	08	236	33	28	4·9072577
Ephraim	89	56	51	269	41	51	4·5307425
Canyon Range	90	18	37	269	46	16	4·8644279
Nebo	143	03	04	322	47	26	4·7651455
Spanish Fork	169	21	41	349	15	10	4·8954328
Indian Head	217	20	55	37	38	48	4·8188333
Bruin	251	47	36	72	26	06	4·9598213
Culmination	278	47	20	99	47	19	5·1397025
Red Plateau	290	49	14	111	17	16	4·8340901
Ellen	241	20	00	161	40	22	5·1724351
Bare Brush	353	32	00	173	33	44	4·5564419

FAYETTE.

A low cliff 4 miles east of the town of Fayette, in Sanpete Co., Utah.

Permanent mark: A small cairn.

[Latitude, 39° 12′ 31″·5. Longitude, 111° 49′ 20″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Valley	38	22	37	218	18	11	4·2107543
Katharine	49	03	11	228	51	09	4·5618306
Musinia	312	12	35	132	21	50	4·5557721
Jura	341	22	19	161	24	25	4·1767984
Gunnison North	359	15	42	179	15	47	3·8751250
Black Cap	359	46	31	179	46	33	4·4505756

GUNNISON NORTH.

The north end of the Gunnison base line, in Sanpete Co., Utah, is in the meridian of the U. S. Engineer monument in the town of Gunnisonand 5,972 feet to the southward.

Permanent mark: A monument of cut stone 1 foot square and standing about 18 inches high.

[Latitude, 39° 08′ 28″·3. Longitude, 111° 49′ 16″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Valley	62	47	26	242	42	55	4·0588179
Fayette	179	15	47	359	15	42	3·8751250
Jura	325	05	08	145	07	10	3·9146604
Black Cap	359	57	49	179	57	49	4·3164200
Gunnison South	359	59	52	179	59	52	3·9916158

GUNNISON SOUTH.

The south end of the Gunnison base line, in Sanpete Co., Utah, is likewise in the meridian of the Engineer Astronomical Station in Gunnison. It is 7 miles to the southward and on the north side of Willow Creek.

Permanent mark: A monument of cut stone, dressed with an edge at top like a gable roof. It stands 6 inches above the ground.

[Latitude, 39° 03′ 10″·2. Longitude, 111° 49′ 16″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Valley	114	10	59	294	06	30	4·0477966
Gunnison North	179	59	52	359	59	52	3·9916158
Jura	236	50	44	56	52	47	3·7494590
Black Cap	359	55	58	179	55	58	4·0379302

VALLEY.

The station was made on the eastern slope of the Valley Range near the base, in Sanpete Co., Utah, 7 miles west northwest from Gunnison.

Permanent mark: A cairn of rocks.

[Latitude, 39° 05′ 38″·8. Longitude, 111° 56′ 20″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Fayette	218	18	11	38	22	37	4·2107543
Gunnison North	242	42	55	62	47	26	4·0588179
Jura	275	41	08	95	47	37	4·1749626
Gunnison South	294	06	30	114	10	59	4·0477966
Black Cap	326	33	45	146	38	11	4·2681391

JURA.

An inconspicuous point among the Jurassic Hills, in Sanpete Co., Utah, 6 miles south southeast from Gunnison.

Permanent mark: A small cairn.

[Latitude, 39° 04′ 49″·7. Longitude, 111° 46′ 00″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Black Cap	18	34	16	198	32	11	4·1687790
Gunnison South	56	52	47	236	50	44	3·7494590
Valley	95	47	37	275	41	08	4·1749626
Gunnison North	145	07	10	325	05	08	3·9146604
Fayette	161	24	25	341	22	19	4·1767984

KATHARINE.

A summit of the Pavant Range, in Millard Co., Utah, 20 miles west southwest from Gunnison and 8 miles east northeast from Fillmore. The point is not the highest of the vicinity and is not acute, but is rounded and bush-covered. A lone tree at the top was used for the station and a small cairn was built near it to identify it.

[Latitude, 38° 59′ 35″. Longitude, 112° 08′ 24″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Belknap	20	28	10	200	17	55	4·8327198
Canyon Range	172	33	18	352	30	38	4·6498542
Nebo	199	25	18	19	39	31	4·9832646
Ephraim	217	07	53	37	22	37	4·7437159
Fayette	228	51	09	49	03	11	4·5618306
South Tent	236	33	28	57	03	08	4·9072577
Musinia	264	16	42	84	37	56	4·6894906
Black Cap	278	41	25	98	53	30	4·4469548
Hilgard	303	23	46	123	46	12	4·7983449
Marvine	309	40	40	129	59	27	4·7514342

BLACK CAP.

An acute conical peak among the Jurassic hills, in Sevier Co., Utah, 2 miles east from Salina.

Permanent mark: A rock cairn.

[Latitude, 38° 57′ 16″·3. Longitude, 111° 49′ 15″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Katharine	98	53	30	278	41	25	4·4469548
Valley	146	38	11	326	33	45	4·2881391
Fayette	179	46	33	359	46	31	4·4505756
Gunnison South	179	55	58	359	55	58	4·0379803
Gunnison North	179	57	49	359	57	49	4·3164200
Jura	198	32	11	18	34	16	4·1687790
Musinia	246	46	17	66	55	26	4·3598409

MUSINIA.

A south southwestern outline of the Wasatch Plateau, in Sevier Co., Utah, 14 miles east southeast from Gunnison. The peak is white and is very conspicuous from the Sevier Valley.

Permanent mark: A small cairn.

[Latitude, 39° 02′ 08″·3. Longitude, 111° 34′ 40″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marvine	7	40	16	187	37	52	4·6152683
Belknap	46	53	03	226	23	41	4·9991085
Black Cap	66	55	26	246	46	17	4·3598409
Katharine	84	37	56	264	16	42	4·6894906
Canyon Range	126	14	13	305	50	21	4·8274974
Fayette	132	21	50	312	12	35	4·5557721
Ephraim	159	11	33	339	04	58	4·6248411
Nebo	169	21	41	349	14	31	4·9418712
South Tent	205	38	23	25	46	45	4·6418233
Bare Brush	260	47	32	80	57	36	4·3694478
Ellen	326	33	00	147	01	32	5·0841937
Thousand Lake	352	51	18	172	54	53	4·8406418
Hilgard	355	40	12	175	41	30	4·5933804

BARE BRUSH.

An outlier at the east edge of the Wasatch Plateau, in Sevier Co., Utah, 27 miles east from the town of Gunnison. The top slopes to the north and breaks off southward in a cliff.

Permanent mark: A cairn 5 feet high.

[Latitude, 39° 04′ 08″·7. Longitude, 111° 18′ 39″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Hilgard	25	21	26	205	12	42	4·6752708
Musinia	80	57	36	260	47	32	4·3694478
South Tent	173	33	44	353	32	00	4·5564419
Bruin	232	07	38	52	44	14	5·0195761
Red Plateau	259	06	40	79	32	51	4·7841618
Culmination	263	41	15	84	39	16	5·1241292
Waas	287	22	43	108	41	02	5·2793519

SAN FRANCISCO.

A well-known volcanic mountain standing on the Colorado Plateau, in Coconino Co., Ariz.

Permanent mark: A stone cairn, 10 feet high.

[Latitude, 35° 20′ 44″·4. Longitude, 111° 40′ 40″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Floyd	93	23	54	272	47	34	4·9787442
Emma	127	27	47	306	35	21	5·2280572
Brink	151	11	19	330	45	12	5·1400820
Paria Station	179	56	05	359	56	01	5·2216020

This station was also determined by Mr. A. P. Davis, in 1885, from the Fort Wingate base line in the triangulation of New Mexico and northeastern Arizona, with the following adopted result: Latitude, 35° 20′ 47″·02. Longitude, 111° 40′ 37″·84.

RED PLATEAU.

A timbered plateau in Emery Co., Utah, with a south-facing cliff standing between Price and San Rafael rivers, and about 30 miles west from Green River.

Permanent mark: A cairn near the most southerly salient.

[Latitude, 39° 10′ 14″·0. Longitude, 110° 37′ 10″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ellen	8	21	43	188	14	23	5·0710545
Hilgard	56	17	11	235	42	22	4·9853721
Bare Brush	79	32	51	259	06	40	4·7841618
South Tent	111	17	16	290	49	14	4·8340901
Indian Head	163	12	17	343	01	56	4·9044670
Bruin	203	51	19	24	01	37	4·7593733
Culmination	267	57	27	88	29	18	4·8609616
Waas	299	42	58	120	35	21	5·1451364

CULMINATION.

A summit of the east Tavaputs Plateau, Grand Co., Utah, 22 miles east from the Green River and 4 miles east from the most southerly salient of the plateau.

Permanent mark: A rock cairn 5 feet high.

[Latitude, 39° 11′ 27″·1. Longitude, 109° 46′ 47″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ellen	37	30	22	216	51	32	4·1734765
Hilgard	70	20	27	249	31	56	5·2121867
Bare Brush	84	39	16	263	41	15	5·1241292
Red Plateau	88	29	18	267	57	27	4·8609616
South Tent	99	47	19	278	47	20	5·1397025
Waas	326	21	46	146	42	32	4·9985435

MARVINE.

The highest point of a rugged comb, in Sevier Co., Utah, separating Moraine and Summit valleys. It is 6 miles north from the foot of Fish Lake.

Permanent mark: A cairn 8 feet high.

[Latitude, 38° 40′ 02″·9. Longitude, 111° 38′ 28″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Adams	31	20	05	210	59	04	4·9797391
Belknap	67	54	14	247	25	23	4·8615500
Katharine	129	59	27	309	40	40	4·7514342
Musinia	187	37	52	7	40	16	4·6152683
Hilgard	258	09	28	78	13	08	3·9368816
Ellen	309	48	05	130	18	53	4·9745688
Pennell	316	27	42	136	59	21	5·0852986
Thousand Lake	333	05	44	153	11	47	4·4949190

HILGARD.

A well-defined peak in Sevier Co., Utah, 5 miles east from Mount Marvine.

Permanent mark: A small cairn.

[Latitude, 38° 41′ 00″·4. Longitude, 111° 32′ 38″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Marvine	78	13	08	258	09	28	3·9368816
Katharine	123	46	12	303	23	46	4·7933449
Ephraim	167	09	09	347	01	18	4·9059241
Nebo	171	20	05	351	11	37	5·1021473
Musinia	175	41	30	355	40	12	4·5933804
South Tent	191	31	53	11	38	54	4·9043279
Bare Brush	205	12	42	25	21	26	4·6752708
Bruin	223	43	19	44	28	34	5·1714955
Red Plateau	235	42	22	56	17	11	4·9853721
Culmination	249	13	56	70	20	27	5·2121867
Ellen	314	13	20	134	40	28	4·9503856
Pennell	320	34	19	141	02	20	5·0178011
Thousand Lake	349	12	56	169	15	20	4·4798016

BELKNAP.

A well-defined, symmetric peak, bare of vegetation; one of the principal summits of the Tushar Mountains in Piute Co., Utah, 10 miles west from Marysvale and 16 miles northeast from Beaver.

Permanent mark: A stone cairn 5 feet high.

[Latitude, 38° 25′ 06″·6. Longitude, 112° 24′ 45″·5.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Little Creek	16	21	54	196	14	25	4·7942160
Brian	24	17	27	204	01	55	4·9532313
Katharine	200	17	55	20	28	10	4·8327198
Musinia	226	23	41	46	53	03	4·9991085
Marvine	247	25	23	67	54	14	4·8615500
Thousand Lake	269	53	18	90	28	06	4·9111942
Adams	341	23	56	161	31	38	4·7558697

THOUSAND LAKE.

Thousand Lake Mountain is a lofty trachytic plateau in Wayne Co., Utah, 3 miles long and nearly 2 miles broad, overlooking Rabbit Valley from the northeast. The station is upon the highest point, a small eminence near the center, visible only from the surrounding summits, not from the valleys. The plateau is difficult of access, but the best approaches for horsemen are from the east and northeast.

Permanent mark: A stone cairn.

[Latitude, 38° 24′ 58″·5. Longitude, 111° 28′ 45″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Adams	50	01	44	229	34	46	4·9208549
Belknap	90	28	06	269	53	18	4·9111942
Marvine	153	11	47	333	05	44	4·4949190
Hilgard	169	15	20	349	12	56	4·4798016
Musinia	172	54	53	352	51	13	4·8406418
Ellen	299	14	01	119	38	43	4·8245111
Pennell	310	04	04	130	29	19	4·8977835

WAAS.

A sharp peak of the La Sal Mountains, in Grand Co., Utah. Seen from the east or west, it appears as the third high peak of the group, counting from the north.

Permanent mark: A stone monument, 11 feet high.

[Latitude, 38° 32′ 18″·6. Longitude, 109° 13′ 41″·8.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Ellen	72	00	34	251	01	30	5·1651987
Bare Brush	108	41	02	287	22	43	5·2793519
Red Plateau	120	35	21	299	42	58	5·1451364
Bruin	142	01	53	321	19	26	5·1941553
Culmination	146	42	32	326	21	46	4·9385435

This position was also determined by Mr. A. P. Davis in 1884, from the Wingate base line, with results as follows: Latitude, 38° 32′ 21″·20 north. Longitude, 109° 13′ 39″·70 west.

ELLEN.

The well defined, most northerly and highest peak of the Henry Mountains, in Garfield Co., Utah.

Permanent mark: A stone cairn, 8 feet high.

[Latitude, 38° 07′ 14″·3. Longitude, 110° 48′ 53″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duffer	39	30	25	……			5·2250042
Thousand Lake	119	38	43	299	14	01	4·8245111
Marvine	130	18	53	309	48	05	4·9745688
Hilgard	134	40	28	314	18	20	4·9503856
Musinia	147	01	32	326	33	00	5·0841937
South Tent	161	40	22	241	20	00	5·1724351
Red Plateau	188	14	23	8	21	43	5·0710545
Bruin	193	18	21	13	35	55	5·2401178
Culmination	216	51	32	37	30	22	4·1734765
Wass	251	01	30	72	00	34	5·1651937
Pennell	……			173	28	20	4.2647348

PENNELL.

A conspicuous peak of the Henry Mountains, in Garfield Co., Utah, 11 miles south of Mount Ellen. The apex is double, the western point being the higher and bearing the monument.

Permanent mark: A stone monument, 7 feet high.

[Latitude, 37° 57′ 21″·4. Longitude, 110° 47′ 27″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Thousand Lake	130	29	19	310	04	04	4·8977835
Marvine	136	59	21	316	27	42	5·0352986
Hilgard	141	02	30	320	34	19	5·0178011
Ellen	173	28	20	……			4·2647348

ADAMS.

A conspicuous summit of the Sevier Plateau, in Garfield Co., Utah, 13 miles north-northeast from Panguitch. The principal eminence is subtabular and timbered. The point occupied is a naked crag at its western edge, visible from the high points of the vicinity but not from the valley of the Sevier.

Permanent mark: A stone monument on an acute natural elevation.

[Latitude, 37° 55′ 53″·8. Longitude, 112° 12′ 20″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Brian	63	20	41	242	57	38	4·7905702
Little Creek	81	02	03	260	47	05	4·5584322
Belknap	161	31	38	341	23	56	4·7558697
Marvine	210	59	04	31	20	05	4·9797391
Thousand Lake	229	34	46	50	01	44	4·9208549
Table Cliff	315	30	43	135	41	50	4·5819377

LITTLE CREEK.

An acute peak of trachyte, in Iron Co., Utah, 11 miles east from Paragoonah and 12 miles west-northwest from Panguitch.

Permanent mark: A stone cairn 6 feet high.

[Latitude, 37° 52′ 48″·4. Longitude, 112° 36′ 43″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Brian	41	08	37	221	00	32	4·4684356
Belknap	196	14	25	16	21	54	4·7942160
Adams	260	47	05	81	02	03	4·5584322
Table Cliff	288	49	18	109	15	24	4·8203700

BRIAN.

The highest point of the Markagunt Plateau, in Iron Co., Utah, 14 miles east from Cedar, 12 miles south from Parowan, and 25 miles west-southwest from Panguitch.

Permanent mark: A cairn of stone 9 feet in diameter and 12 feet high.

[Latitude, 37° 40′ 49″·3. Longitude, 112° 49′ 58″·1.

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Belknap	204	01	55	24	17	27	4·9532318
Little Creek	221	00	32	41	08	37	4·4684356
Adams	242	57	38	63	20	41	4·7905702
Table Cliff	269	17	57	89	52	00	4·9134971
Pink Cliff	302	49	51	123	08	24	4·7291831
Navajo Well	324	25	48	144	45	56	4·9265047
Three Trees	351	08	54	171	13	45	4·8888201

TABLE CLIFF.

The extreme southward salient of a high plateau in Garfield Co., Utah, separating Panguitch Hayfields from Potato Valley. The only approach is from the north.

Permanent mark: A triangular crib of logs, 15 feet on a side and 8 feet high.

[Latitude, 37° 41′ 08″·7. Longitude, 111° 54′ 08″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duffer	6	54	44	186	50	41	4·9166919
Mollie	16	22	23	196	16	48	4·6818306
Navajo Well	25	47	14	205	33	25	4·8866122
Three Trees	42	39	56	222	10	56	5·0188786
Pink Cliff	51	23	29	231	08	05	4·6775175
Brian	89	52	00	269	17	57	4·9134971
Little Creek	109	15	24	288	49	18	4·8203700
Adams	135	41	50	315	30	43	4·5819377
Paria Station	347	57	47	168	05	52	4·9783859

PINK CLIFF.

On the south edge of the Pownsagunt Plateau, in Kane Co., Utah, 11 miles north from Skumpah or Clarkston, and 8 miles southeast from Upper Kanab.

Permanent mark: A triangular crib of logs, 15 feet on a side and 8 feet high.

[Latitude, 37° 25′ 02″·7. Longitude, 112° 19′ 21″·1.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Three Trees	35	14	27	215	00	50	4·7623467
Brian	123	08	24	302	49	51	4·7291831
Table Cliff	231	08	05	51	23	29	4·6775175
Mollie	304	31	41	124	41	27	4·4591229
Duffer	332	11	51	152	23	04	4·7703829
Navajo Well	354	26	26	174	28	02	4·6001607

MOLLIE.

An outlier of the white cliff sandstone standing near the west fork of Paria Creek, in Kane Co., Utah, about 7 miles northwest from Paria Settlement. It is an acute butte.

[Latitude, 37° 16′ 12″·3. Longitude, 112° 03′ 18″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Three Trees	61	42	36	241	19	15	4·8125077
Pink Cliff	124	41	27	304	31	41	4·4591229
Table Cliff	196	16	48	16	22	23	4·6818306
Paria Station	324	28	49	144	42	23	4·7604373
Duffer	354	08	47	174	10	17	4·5564336

TITHING YARD.

In the northwest corner of the public square at Kanab, in Kane Co., Utah, is the Tithing Office Yard, inclosed by a stone wall. In the northwest corner of this inclosure, close to the wall, stands a low monument of sandstone, square at top and marked 76 ft. east of B. L. This is not a station of the triangulation, but marks the "Street" station, which was 76 feet west of it.

[Latitude, 37° 02′ 55″·9. Longitude, 112° 31′ 50″.]

STREET.

This station marks the position of the astronomical pier from which was determined the latitudes and longitudes depending upon the Kanab Base, and is in its meridian. It was originally located in the northwest corner of the public square of the village of Kanab, but owing to a change in the boundaries of the square which threw the location into a street, no permanent mark was set to indicate its exact position. A stone witness post was set firmly in the ground in the Tithing Office Square exactly seventy-six feet due east of the observing pier. This stone is marked 76 feet east of B. L.

[Latitude, 37° 02′ 55″·85. Longitude, 112° 31′ 50″·83.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kanab South	000	00	08	180	00	08	4·2146235
John..............	274	30	32	94	31	05	3·1275988

JOHN.

On a salient of the Vermilion Cliff, at the eastern edge of the town of Kanab, in Kane Co., Utah.

Permanent mark: A cairn of stone 4½ feet high.

[Latitude, 37° 02′ 52″·5. Longitude, 112° 30′ 56″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kanab South	4	42	18	184	41	46	4·2182806
Street	94	31	05	274	30	32	3·1275988
Shinarump	325	54	54	145	57	25	4·0457813

MANSARD.

A white, conspicuous sandstone knob on the Vermilion Cliff, in Kane Co., Utah, 5½ miles east of Kanab and 3½ miles southwest of Johnson. The station overlooks the road from Kanab to Johnson, but can not be approached with horses from that side.

Permanent mark: A conoid boss of eroded sandstone.

[Latitude, 37° 02′ 52″·3. Longitude, 112° 25′ 22″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shinarump	12	34	34	192	33	45	3·9742210
New	48	08	23	228	02	06	4·3099647
Pipe	61	20	27	241	06	20	4·5952529
Three Trees	75	36	47	255	26	53	4·4023059
Navajo Well	263	49	48	83	55	03	4·1087869
Brow	357	36	37	177	37	21	4·7060202

NAVAJO WELL.

A southward salient of the Vermilion Cliff, in Kane Co., Utah, overlooking Navajo Well. The station is on the highest point of a peninsular mass, the flat top of which slopes gently to the northwest and is an acre in extent. It can be reached only from the north.

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Permanent mark: A cairn of stone and wood, 10 feet in diameter.

[Latitude, 37° 03′ 36″·7. Longitude, 112° 16′ 45.″]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Shinarump	54	34	34	234	28	29	4·2603437
New	61	52	57	241	41	32	4·5017003
Three Trees	78	28	11	258	13	03	4·5799215
Mansard	83	55	03	263	49	48	4·1087869
Brian	144	45	56	324	25	48	4·9265047
Pink Cliff	174	28	02	354	26	26	4·6001607
Table Cliff	205	33	25	25	47	14	4·8866122
Duffer	297	53	05	118	02	45	4·4269204

THREE TREES.

A high point on the Vermilion Cliff, in Coconino Co., Ariz., three miles west from Wolf Spring. It can be approached on horseback only from the north. The eminence is sandy and was covered with pine. All but three of the trees were felled and from those the lower branches were cut so as to leave tall shafts, with tufts of foliage at the top. The one used as the monument is the most northerly of the three and stands on higher ground than the others. The others were merely to aid in the identification of the station. To an observer standing at New, Brink, Brow, or Brian the monument appears as the middle tree. From Pipe and Emma it appears at the left of the others. From Kanab South, Shinarump, Navajo Well, Mansard, Table Cliff, and Pink Cliff it appears at the right.

[Latitude, 36° 59′ 27″·6. Longitude, 112° 41′ 51″·3.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Emma	27	50	01	207	32	50	4·9598813
Pipe	38	30	31	218	26	14	4·2082578
Brian	171	13	45	351	08	54	4·8888201
Pink Cliff	215	00	50	35	14	27	4·7623467
Table Cliff	222	10	56	42	39	56	5·0188786
Mollie	241	19	15	61	42	36	4·8125077
Mansard	255	26	58	75	36	47	4·4023059
Navajo Well	258	13	03	78	28	11	4·5799215
Shinarump	277	16	03	97	25	08	4·3540809
New	308	17	12	128	20	45	4·0725590
Brow	328	59	15	149	09	46	4·7146050
Brink	338	03	28	158	13	12	4·8236043

KANAB-NORTH.

The north end of the Kanab base line, in Coconino Co., Ariz., about six miles south of Kanab. Its position is a few rods to the left of the road leading from Kanab to Demotte Park and is on a low knoll of sand.

Permanent mark: A monument of basalt firmly bedded and engraved, with a + on its upper surface.

[Latitude, 36° 57′ 46″·5. Longitude, 112° 31′ 21″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kanab-South	6	03	55	186	03	37	3·8384985
New	56	16	56	236	14	20	3·8800354
Shinarump	268	05	09	88	07	54	3·8351940

KANAB-SOUTH.

The south end of the Kanab base line, in Coconino Co., Ariz. The station is about 10 miles south of Kanab and is approximately in the meridian of the Street station. It stands at the crest of a low cliff, facing southward, and is about midway between the Kanab Wash and the road to Demotte Park. It is marked, like Kanab-North, by a monument of basalt and a target of wood. Touching the monument is a bedded block of conglomerate, on which is scratched the meridian mark of the astronomical station, Street.

[Latitude, 36° 54′ 04″·1. Longitude, 112° 31′ 50″·9.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
New	115	20	45	295	18	30	3·7907466
Street	180	00	08	000	00	08	4·2146235
John	184	41	46	4	42	18	4·2132806
Kanab-North	186	03	37	6	03	55	3·8384985
Shinarump	226	52	50	46	55	54	4·0155937

NEW.

On a salient of the Shinarump Cliff, in Coconino Co., Ariz., 9 miles in a southwest direction from Kanab. The station overlooks the lower road from Kanab to Pike Spring, near the point where it is joined by the road from Johnson. The conglomerate capping the salient is severed by erosion from the main mass at the north and is not easily scaled, except at a point near the saddle.

Permanent mark: A + engraved on the bare conglomerate.

[Latitude, 36° 55′ 29″·8. Longitude, 112° 35′ 36″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Emma	35	19	46	214	59	04	4·9532142
Pipe	74	40	50	254	33	00	4·3021528
Three Trees	128	20	45	308	17	12	4·0725590
Mansard	228	02	06	48	08	23	4·3099647
Kanab-North	236	14	20	56	16	56	3·8800354
Navajo Well......	241	41	32	61	52	57	4·5017008
Shinarump	251	17	56	71	23	16	4·1423256
Kanab-South	295	18	30	115	20	45	3·7907466
Brow	334	53	45	155	00	44	4·6126907
Brink.............	344	03	38	164	09	51	4·7533245

PIPE.

A salient of the Vermilion Cliff, Coconino Co., Ariz., 4 miles west from Pipe Spring. The only approach for horses is from the north.

Permanent mark: An acute natural boss of sandstone.

[Latitude, 36° 52′ 37″·8. Longitude, 112° 48′ 37″·4.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Emma	25	29	12	205	16	17	4.8771504
Three Trees	218	26	14	38	30	31	4·2082578
Mansard	241	06	20	61	20	27	4·5952520
New	254	33	00	74	40	50	4·3021522
Brow	310	46	26	131	01	13	4·6866137
Brink	324	30	50	144	44	49	4·7804136

SHINARUMP.

On a salient of the Shinarump Cliff, in Coconino Co., Ariz., 7½ miles southeast from Kanab. The station is in Arizona.

Permanent mark: A cairn of stone 5 feet high.

[Latitude, 36° 57′ 53″·9. Longitude, 112° 26′ 45″·0.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Kanab-South	46	55	54	226	52	50	4·0155937
New	71	23	16	251	17	56	4·1423236
Kanab-North	88	07	54	268	05	09	3·8351940
Three Trees	97	25	08	277	16	03	4·3540809
John	145	57	25	325	54	54	4·0457313
Mansard	192	33	45	12	34	34	3·9742210
Navajo Well	234	28	29	54	34	34	4·2603437

DUFFER.

The north part of the Paria Plateau is bounded on the west by a parapet of red sandstone, abounding in craggy points, in Coconino Co., Ariz. The highest of these is the Duffer Station.

Permanent mark: A small cairn perched on a summit naturally acute.

[Latitude, 36° 56′ 50″·1. Longitude, 112° 00′ 50″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Navajo Well	118	02	45	297	53	05	4·4269204
Pink Cliff	152	23	04	332	11	51	4·7703329
Mollie	174	10	17	354	08	47	4·5564336
Table Cliff	186	50	41	6	54	44	4·9166919
Paria Needle	289	54	02	110	06	00	4·4982456
Paria Station	290	23	31	110	35	33	4·5021502
Ellen				39	30	25	5·2250042

PARIA STATION.

The southern edge of the Paria Plateau, in Coconino Co., Ariz., is characterized by a series of sandstone mesas from 100 to 200 feet high.

The one nearest to Lee's Ferry was used as a station. It can be approached only from the north and west.

Permanent mark: A cairn of stone and wood 10 feet high.

[Latitude, 36° 50′ 49″·2. Longitude, 111° 40′ 47″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duffer	110	35	33	290	23	31	4·5021502
Mollie	144	42	23	324	28	49	4·7604373
Paria Needle	153	59	48	333	59	44	2·5944976
Table Cliff	168	05	52	347	57	47	4·9783859
San Francisco	359	56	01	179	56	05	5·2216020

PARIA NEEDLE.

Close to Paria Station, in Coconino Co., Ariz., is a butte of sandstone so acute that it can not be scaled by ordinary means. It is a fine natural target and was determined as an accessory to Paria Station, to be used in observations from a great distance.

[Latitude, 36° 51′ 00″·6. Longitude, 111° 40′ 54″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Duffer	110	00	00	289	54	02	4·4982456
Paria Station	333	59	44	153	59	48	2·5944976

BROW.

The Kaibab Plateau, in Coconino Co., Ariz., has a broad, flat top covered with timber. Brow Station is on the western edge of a flanking bench, 4 miles east of the large spring in Sawmill Canyon.

Permanent mark: A small tree from which the lower branches are cut so as to leave a tuft at top. About its base is piled a triangular pyramid of stone 8 feet high.

[Latitude, 36° 35′ 25″·0. Longitude, 112° 23′ 56″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Brink	6	07	44	186	06	59	4·2421579
Emma	62	34	54	242	07	22	4·8930123
Pipe	130	01	13	310	46	26	4·6866137
Three Trees	149	09	46	328	59	15	4·7146050
New	155	00	44	334	53	45	4·6126907
Mansard	177	37	21	357	36	37	4·7060202

BRINK.

On the western edge of the Kaibab Plateau, at the point where it is cut by the Grand Canyon of the Colorado, in Coconino Co., Ariz. The vicinity of the station was cleared of timber except 2 pines, and those were deprived of their lower branches. The station is the more easterly tree, and is marked by a target of logs 10 feet long and 10 feet high, facing to the west.

[Latitude, 36° 26′ 01″·6. Longitude, 112° 25′ 11″·6.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Floyd	13	27	27	193	16	44	5·0748098
Emma	74	33	45	254	07	01	4·8453623
Pipe	144	44	49	324	30	50	4·7804136
Three Trees	158	13	12	338	03	28	4·8236043
New	164	09	51	344	03	38	4·7533245
Brow	186	06	59	6	07	44	4·2421579
San Francisco	330	45	12	151	11	19	5·1400820

EMMA.

The most southerly high summit of the Uinkaret Mountains, in Coconino Co., Ariz. The peak is a symmetric cone of volcanic scoria, covered with bushes, and overlooking the Grand Canyon. The bushes were cut away from the summit and piled in a heap with a packing of earth, to form a target. The target is 12 feet in diameter at base and 12 feet high, with a staff at top.

[Latitude, 36° 15′ 48″·1. Longitude, 113° 10′ 16″·7.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Pipe	205	16	17	25	29	12	4·8771504
Three Trees	207	32	50	27	50	01	4·9598818
New	214	59	04	35	19	46	4·9532142
Brow	242	07	22	62	34	54	4·8930123
Brink	254	07	01	74	33	45	4·8453623
San Francisco	306	35	21	127	27	47	5·2280572
Floyd	337	11	31	157	27	13	5·0200243

FLOYD.

A well-known trachytic peak standing on the Colorado Plateau, in Yavapai Co., Ariz.

Permanent mark: A cairn 12 feet high.

[Latitude, 35° 23′ 31″·2. Longitude, 112° 43′ 27″·2.]

To station.	Azimuth.			Back azimuth.			Log. dist.
	°	′	″	°	′	″	*Meters.*
Emma	157	27	13	337	11	31	5.0200243
Brink	193	16	44	13	27	27	5·0748098
San Francisco	272	47	34	93	23	54	4·9787442

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DEPARTMENT OF THE INTERIOR

BULLETIN

OF THE

UNITED STATES

GEOLOGICAL SURVEY

No. 123

WASHINGTON
GOVERNMENT PRINTING OFFICE
1895

UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

A
DICTIONARY OF GEOGRAPHIC POSITIONS
IN
THE UNITED STATES

COMPILED BY

HENRY GANNETT
CHIEF TOPOGRAPHER

WASHINGTON
GOVERNMENT PRINTING OFFICE
1895

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF TOPOGRAPHY,
Washington, D. C., November 23, 1894.

SIR: I beg to transmit herewith, for publication as a bulletin, a compilation of positions determined within the limits of the United States.

Very respectfully,

HENRY GANNETT,
Chief Topographer.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

JUL 5 18[illegible]

A DICTIONARY OF GEOGRAPHIC POSITIONS.

By Henry Gannett.

INTRODUCTION.

For several years the Division of Topography of the United States Geological Survey has been engaged in compiling positions determined within the United States which are believed to be of sufficient accuracy for use in the preparation of its maps. This compilation has been found extremely useful in the office, and it is believed that its usefulness will be greatly extended by placing it before the public.

This list comprises between 9,000 and 10,000 positions. To publish it in extenso, with descriptions of the stations, their latitudes and longitudes, the distances and azimuths to neighboring stations, and the methods of determination, would extend this bulletin beyond all reasonable limits. To avoid making too bulky a volume, it has been decided to publish merely the latitudes and longitudes, with abbreviations indicating the authority, and references to the publications in which other data relating to the positions may be found.

The arrangement of these positions is the result of much thought, and that presented is believed to be the most convenient for the purposes for which such a compilation is needed. The positions are arranged by States and, within States, by "square degrees;" i. e., the quadrilateral limited by consecutive parallels and meridians. The States are arranged geographically, beginning with Maine and ending with California. Within the States the square degrees commence with the northeasternmost and run westward across the State; then they begin again with the eastern end of the next tier southward, and so on to the southwest corner of the State.

Within each square degree the positions are arranged alphabetically by name. The only exception to this is in the case of section corners in certain States on the prairies and plains. These section corners will be found at the end of their respective square degrees.

The controlling reason for the selection of this method of arrangement is that the most common requirement is for all positions within a certain area, and since that area may be large, such as the area of the State, or small, as, for instance, the neighborhood of a city, such a requirement will be met by this arrangement better than by any other, except, possibly, an arrangement by counties. An unbroken alphabetical arrangement, either by States or by the United States, would be practically worthless for the use of surveyors.

AUTHORITIES.

The authorities which have contributed in any appreciable degree to geodetic determinations of positions in this country are few in number. They are as follows:

United States Coast and Geodetic Survey.

United States Geological Survey.

United States Lake Survey.

Mississippi River Commission.

Missouri River Commission.

United States Geological and Geographical Survey of the Territories. (Hayden Survey.)

United States Geographical and Geological Survey of the Rocky Mountain Region. (Powell Survey.)

United States Geographical Surveys West of the One Hundredth Meridian. (Wheeler Survey.)

New York State Survey.

By the above nine organizations 99 per cent of all determinations have been made. In addition to these a few determinations have been made by the United States Engineer Corps, by the New Jersey State Survey, by observatories, etc.

It is in order here to describe the work of each of these nine organizations, the parts of the country in which their work has been done, its extent, and the methods employed both in field and office, and to characterize the degree of accuracy which may be expected in their determinations.

UNITED STATES COAST AND GEODETIC SURVEY.

This organization, the oldest in the country, has been engaged in geodetic work for more than half a century. Its determinations are found all along the coast of the Atlantic, Gulf, and Pacific. Besides the work immediately connected with the coast, it has extended its triangulation and astronomic determinations of positions far inland in many directions and for different purposes. The greater part of New England, New York, and New Jersey, and much of Pennsylvania, are covered by its positions. From the head of Chesapeake Bay it has extended a series of quadrilaterals southwestward down the east front of the Appalachian Mountains to central Alabama. It has extended a belt of triangulation across the United States in the neighborhood of the thirty-ninth parallel. In aid of State surveys it has done much triangulation in interior States, including Wisconsin, Minnesota, Kentucky, and Tennessee.

Altogether many thousands of points of primary, secondary, and tertiary grades have been determined. Most of those published in the reports of this organization, however, rest upon fundamental data which are now discarded. Those published in the reports prior to 1870 rested upon chronometric determinations from Greenwich, or, still worse, upon assumed initial positions. All those published prior to 1880 were computed upon the Bessels spheroid of revolution, which has now been discarded in favor of Clarke's. Consequently all determinations published in the reports of this Survey prior to 1880 have been omitted from this compilation, since it is believed that an attempt to use them would only lead to error. The positions of the United States Coast and Geodetic Survey which are included in this publication are, first, those published since 1880, which are found almost entirely in southern New England and New York, and, second, a large number scattered widely over the country, which have been furnished to the United States Geological Survey in manuscript by the United States Coast and Geodetic Survey. They are upon Clarke's spheroid of revolution.

The work of this organization is of the highest order, bearing comparison with the best executed elsewhere in the world. For all purposes of mapmaking their determinations may be accepted without question of accuracy, however large may be the scale for which they are needed.

Astronomic determinations have been made by the best modern methods and instruments and by trained observers. The geodetic work has been done with a great variety of instruments, but in all cases with the best in use at the time. The results have been adjusted by least squares, and all determinations in the northeastern part of the country rest upon mean astronomical positions.

The abbreviation used for this organization in the following tables is "C. & G. S." The references are to its annual reports, abbreviated to "Rept.," with the last two figures of the date. Other references coupled with this authority are the first volume of the final report of the New Jersey State Survey, abbreviated to "Final Rept., Vol. 1," and Bulletin 122 of the United States Geological Survey, abbreviated to "Bull. 122." In cases where no reference is given it is to be understood that the data are not published in full. In such cases they can commonly be obtained by correspondence with the Superintendent of the United States Coast and Geodetic Survey.

UNITED STATES GEOLOGICAL SURVEY.

This organization has been engaged since 1882 in preparing a map of the country upon scales ranging from 1:250000 to 1:62500. For the primary control of these maps much triangulation has been executed. This is scattered widely over the country, and many thousand determinations have been made. To specify the localities would be to enumerate nearly every State in the Union. The extent of this triangulation and the results accomplished are fully set forth in detail in Bulletin 122 of this organization.

This triangulation has been executed solely for the control of maps upon the above-mentioned scales, and, being simply a means toward a certain end, the extreme of accuracy has not been aimed at, but only such degree of accuracy as is required for the purpose. All the determinations are, however, believed to be of ample accuracy for the control of maps upon a scale of 1 mile to an inch.

Astronomic determinations have been made with the best instruments and the most approved methods. Triangulation has been done with a variety of instruments, from 6-inch theodolites, reading by vernier to ten seconds, up to 8-inch theodolites, reading by microscope to two seconds. Most of the work has been subjected to a least-square adjustment, although this refinement has not always been introduced.

All determinations are upon Clarke's spheroid.

In the tables the determinations of the United States Geological Survey are designated by the abbreviation "G. S." The reference given for nearly all of them is Bulletin 122 ("Bull. 122"), and for the rest Bulletins 49 and 70.

UNITED STATES LAKE SURVEY.

This organization was engaged for many years in a survey of the shores of the Great Lakes. The charts were controlled by geodetic work of high order, comparable with that of the United States Coast and Geodetic Survey. The determinations of positions are upon the shores of the Great Lakes and the St. Lawrence River, besides a belt of triangulation from the foot of Lake Erie to the head of Lake Michigan, and from the head of Lake Michigan southward in eastern Illinois nearly to the Ohio River.

The positions determined by this organization are published under the following title: "Professional Papers, Corps of Engineers, No. 24, Primary Triangulation, United States Lake Survey."

All positions determined are reduced to the Clarke spheroid.

In the following tables the Lake Survey is designated by the initials "L. S.," and the report above mentioned "Final Rept."

MISSISSIPPI RIVER COMMISSION.

This organization is engaged in a survey of that river, controlling it by triangulation, by means of which a large number of points have been located along its course, extending from southern Louisiana into Illinois. The accuracy of these determinations is amply sufficient for the scale of 1:20000, the largest scale upon which the maps have been issued. These determinations are upon the Clarke spheroid.

In the tables this organization is represented by the abbreviation "Miss. R. C.," and the references are, in the main, to its annual reports, which are published as a part of the reports of the Chief of Engineers, U. S. A.

MISSOURI RIVER COMMISSION.

The work of this organization is very similar to that of the Mississippi River Commission. Its determinations extend from the mouth of the river to its head, with one or two breaks in continuity. The positions are determined with ample accuracy for the control of maps upon a scale of 1 mile to 1 inch, and are reduced to the Clarke spheroid. They are indicated by the abbreviation "Mo. R. C.," and in most cases the references are to the annual reports of the Commission, which are published in connection with the reports of the Chief of Engineers, U. S. A.

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

This organization, under the directorship of Dr. F. V. Hayden, surveyed between 1873 and 1878 considerable areas in Colorado, Idaho, Utah, and Wyoming upon a scale of 4 miles to 1 inch. The triangulation executed for the control of this work is believed to be of sufficient accuracy for the control of maps upon larger scales, even up to 1 mile to an inch. The work was done with 8-inch theodolites, reading by vernier to ten seconds, and was adjusted by a graphic method. The positions were reduced to the Bessels spheroid. In the tables they are distinguished by "Hayden" as authority, and referred to the annual reports of that organization for the years 1876 and 1877.

UNITED STATES GEOGRAPHICAL AND GEOLOGICAL SURVEY OF THE ROCKY MOUNTAIN REGION.

This organization, popularly known as the Powell Survey, mapped between 1872 and 1878 the greater part of Utah and northern Arizona. The triangulation upon which the work rests was executed with 8-inch theodolites, reading by vernier to ten seconds, and was adjusted by least squares. While used for the control of maps upon a scale of 4 miles to 1 inch, it is believed to be of sufficient accuracy for maps of 1 inch to the mile. The results were reduced to the Clarke spheroid and are designated in the tables by "Powell," and reference is made to Bulletin 122 of the United States Geological Survey, in which they have been published.

UNITED STATES GEOGRAPHICAL SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN.

These surveys were carried on between the years 1867 and 1878 under the directorship of Maj. (then Lieut.) George M. Wheeler, of the Corps of Engineers, U. S. A. Prior to 1873 the work was done entirely by traverse. In later years it was controlled by triangulation. This was executed merely for the control of maps upon a scale of 4 miles to an inch. The instruments used were theodolites, reading by vernier to ten seconds, and the results were adjusted by least squares. They are reduced to the Bessels spheroid. In the tables the work of this organization is designated by "Wheeler," and reference is made to the annual reports of the organization.

Determinations in the Rocky Mountain region will be found to exhibit discrepancies of magnitude. These are due to two causes; one, the fact that certain organizations have used the Bessels spheroid and the others that of Clarke. The discrepancies due to this cause are, however, small in amount, ranging from one to three seconds of latitude and longitude. The other source of discrepancy is due to station errors. The station errors in this region are often large, owing to the high relief of the country. In certain cases they are known to be as great as a fourth of a mile, and further investigation will doubtless develop much larger ones. These can not be adjusted until numerous astronomical determinations, scattered widely over the country, have been connected by triangulation and mean results obtained to which all determinations may be reduced.

NEW YORK STATE SURVEY.

This organization, under the directorship of Mr. James T. Gardiner, executed a large amount of geodetic work in that State during the fourteen years of its existence, 1874 to 1887, inclusive. This work is of a high order, amply sufficient for maps upon almost any scale for which they may be required. The results are upon the Clarke spheroid.

The abbreviation used for this authority is "S. S.," and the reference is to the final report of the Survey.

LIST OF POSITIONS.

MAINE.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			69°-70°				
	°	′	″	°	′	″		
Bigelow	44	42	47.91	69	43	39.72	G. S	Bull. 122.
Blin		07	14.72		40	52.26	C. & G. S	
Bowman		32	31.67		41	56.60	G. S	Do.
Costellow		02	52.89		46	07.01	C. & G. S	
Hornbeam		28	32.84		57	05.58	G. S	Do.
Houdlette		05	02.42		46	15.46	C. & G. S	
Iron Hill		12	45.95		47	07.66	do	
Layton Hill		10	22.86		45	50.25	do	
Marco		35	21.72		38	49.84	G. S	Do.
Maxwell		02	12.98		50	35.66	C. & G. S	
Merserve		08	44.79		44	29.27	do	
Monks Hill		21	36.25		53	00.15	G. S	Do.
Quaker		26	08.63		46	30.63	do	Do.
Telegraph Hill		10	28.12		44	43.49	C. & G. S	
Winter		16	54.54		44	27.94	G. S	Do.
	44°-45°			70°-71°				
Mount Blue	44	43	41.43	70	20	33.16	C. & G. S	
Pisgah		18	22.67		01	27.66	do	Do.
Sabattus		08	37.83		04	43.74	do	Do.
	43°-44°			69°-70°				
Cushman	43	58	44.04	69	40	46.62	do	
Edgecomb		57	13.76		36	18.53	do	
Great Hill		53	46.92		51	14.54	do	
Haggett		59	44.31		36	18.62	do	
Hodgkins		58	43.48		48	48.18	do	
Norwood		59	54.33		33	56.38	do	
Sprague		58	31.90		53	64.89	do	
	43°-44°			70°-71°				
Adams	43	52	53.95	70	23	28.51	G. S	Do.
Agamenticus		13	24.63		41	32.91	C. & G. S	Do.
Bauneg Beg		23	08.18		47	07.26	G. S	Do.
Biddeford:								
New slate spire		29	38.00		27	40.80	do	
Congregational church spire		29	34.20		27	26.59	do	
Tall spire		29	31.80		27	32.64	C. & G. S	
Baptist church spire		29	40.50		27	30.53	do	
Billings Hill		04	08.13		41	30.66	do	
Bradbury		54	08.01		10	56.36	do	
Cape Elizabeth:								
West light-house (1874)		33	51.57		12	11.04	do	
East light-house (1874)		33	58.15		12	02.43	do	
East Sister		04	06.48		40	01.04	do	
Farnham		30	05.77		55	47.06	G. S	Do.
Fort Sullivan		04	32.64		44	00.94	C. & G. S	
Fort Washington		04	26.21		44	27.57	do	
Freeport:								
Church		51	28.13		06	12.86	do	
Dark spire		51	45.53		36	08.35	do	
Frost Hill		09	45.00		47	23.93	do	
Gorham		40	50.60		26	49.96	G. S	Do.
Groveville church spire		39	52.90		31	10.60	do	
Kennebunk:								
Town clock		23	16.70		32	15.90	do	
Spire		23	13.10		32	15.10	do	
Kittery Point		04	44.60		42	52.72	C. & G. S	
Mount Independence		45	33.75		19	14.34	do	Do.
Mount Pleasant		01	36.69		59	21.94	do	
Munjoy		39	55.64		14	55.64	do	Do.
Ossipee		35	18.87		44	27.66	do	Do.
Portland Head light-house		37	23.51		12	30.23	do	

MAINE—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			70°-71°				
	°	′	″	°	′	″		
Rattlesnake, wooded summit	43	58	01.10	70	29	10.90	G. S	Bull. 122.
Saco, church		30	02.96		28	35.06	C. & G. S	
Sawyer		44	41.00		45	13.06	G. S	
Sebago Hill, tall dead tree		50	40.20		43	48.00	do	
Sebago Bald Hill, pine tree		51	53.30		41	57.30	do	
Seward		04	11.19		40	44.91	C. & G. S	
Tare Shirt		19	15.90		49	20.85	G. S	Do.
West Sister		03	42.98		40	21.62	C. & G. S	
Whale Back		03	31.59		41	49.26	do	
Light-house (1878)		03	31.80		41	48.56	do	
Light-house (1850)		03	31.70		41	49.05	do	
Wood Island		03	46.23		41	52.34	do	
White Island		03	35.42		41	20.10	do	
Windham, church		47	50.70		25	26.60	G. S	
Wood Island light-house		27	24.70		19	46.25	C. & G. S	
Wooded Knob		54	16.00		39	18.60	G. S	
Yarmouth:								
Yellow spire		48	12.70		11	47.07	C. & G. S	
White spire		47	58.28		11	01.80	do	
York		46	43.45		11	08.88	do	
	42°-43°			70°-71°				
Isle of Shoals, Hog Island	42	59	14.86	70	36	50.28	do	

NEW HAMPSHIRE.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			71°-72°				
	°	′	″	°	′	″		
Agassiz	44	15	58.17	71	40	38.05	G. S	Bull. 122.
Carrigain		05	37.23		26	50.87	do	Do.
Ingalls		28	16.90		02	22.00	C. & G. S	
Iron Mountain		08	03.02		14	22.65	G. S	Do.
Kearsarge		06	21.06		05	41.12	do	Do.
Lafayette		09	38.92		38	41.66	C. & G. S	Do.
Moat		02	35.70		12	55.18	G. S	Do.
Moriah		20	24.90		07	55.40	C. & G. S	
Mount Washington:								
Chimney		16	14.44		18	11.49	do	Do.
Tower		16	14.06		18	13.65	do	Do.
Prospect Hill		27	05.88		34	16.80	G. S	Do.
South Baldface		13	51.46		04	42.45	do	Do.
Starr King		26	04.50		25	59.80	C. & G. S	Do.
	43°-44°			70°-71°				
Blunt Island	43	03	25.95	70	43	53.46	do	
Boatswain Hill		03	57.17		43	26.43	do	
Clark Island		04	34.36		43	28.63	do	
Clark Island, 2		04	37.30		43	28.50	do	
Fort Constitution		04	18.06		42	34.67	do	
Foss Rye		00	45.81		44	21.28	do	
Frost Hill		03	35.25		43	36.27	do	
Frost Point		03	11.01		43	10.86	do	
Garrison		12	34.63		52	12.71	do	
Jerrys Fort		03	26.92		42	45.66	do	
Newcastle		03	37.10		43	20.49	do	
Portsmouth Harbor:								
Northwest base (1842)		02	55.73		43	14.19	do	
Newcastle light-house (1850–1878)		04	16.10		42	32.92	do	
Pulpit Rock		01	58.54		43	08.31	do	
Salter Island		03	57.00		44	49.78	do	
Stratham Hill		02	22.53		53	26.26	do	
Tower		04	13.70		42	45.68	do	
Wentworth Height		03	41.46		44	29.38	do	
	43°-44°			71°-72°				
Chocorua	43	57	16.17	71	16	26.36	G. S	
Patuccawa		07	13.69		11	51.32	C. & G. S	Rept. '85.
	43°-44°			72°-73°				
Hanover	43	42	15.20	72	17	07.95	do	
Observatory Hill, New Dartmouth College.		42	19.79		17	08.07	do	
	42°-43°			70°-71°				
Great Boars Head	42	55	05.43	70	47	45.93	do	
Hampton		56	33.94		49	37.92	do	
Hampton Falls		54	44.37		53	51.88	do	
Little Boars Head		57	28.88		46	33.80	do	
Seabrook		52	29.59		49	06.55	do	

NEW HAMPSHIRE—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
	°	′	″	°	′	″		
Philbrick	42	56	59.66	71	07	14.70	C. & G. S	
Unkonoonuc		58	59.86		35	19.38	do	
	42°-43°			72°-73°				
Monadnock	42	51	41.17	72	06	30.78	do	

VERMONT.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			72°-73°				
	°	′	″	°	′	″		
Potato Hill	44	07	13.69	72	56	12.04	C. & G. S	
	44°-45°			73°-74°				
Apple Tree Point	44	29	50.37	73	16	27.77	do	
Barber Hill		18	10.20		15	33.44	do	
Comstock Hill		23	26.66		15	40.46	do	
Fields Hill		12	30.92		13	59.58	do	
Head		49	49.65		20	35.59	do	
Hen Island		49	22.00		16	20.26	do	
Hill		52	42.35		20	01.76	do	
Island La Motte light-house		54	23.46		20	38.16	do	
Juniper Island		26	57.70		16	39.23	do	
Sawyer Island		39	00.63		21	21.05	do	
Saxton Point		23	48.44		16	45.11	do	
Smith		00	34.83		22	22.85	do	
Snake Mountain tower		03	41.91		16	52.11	do	
Whitford		04	16.32		17	31.84	do	
Windmill Point light-house		58	54.65		20	32.28	do	
	43°-44°			72°-73°				
Ascutney	43	26	46.74	72	27	08.48	do	
Colton		57	10.24		22	03.21	do	
Gile		47	20.78		21	07.33	do	
Glebe		11	20.23		45	41.10	do	
Goshen		49	46.72		58	16.87	do	
Killington		36	17.50		49	14.28	do	
Rochester		52	01.29		44	55.15	do	
Styles		16	25.20		56	18.41	do	
West Hawks		22	04.86		34	50.60	do	
	43°-44°			73°-74°				
Fletcher	43	59	27.01	73	18	41.26	do	
Forbes		29	28.26		19	46.83	do	
French		47	55.50		21	43.16	do	
Herrick (1882)		33	45.67		05	58.07	do	
Landon		47	41.04		11	05.51	do	
Mount Defiance		49	53.15		24	25.45	do	
Mount Equinox		09	57.98		07	02.71	do	
Northeast		26	07.49		10	02.75	do	
Poultney, Baptist church		30	57.02		14	16.17	do	
Rupert		18	28.23		12	00.46	G. S	
Sisson Hill		52	59.72		19	50.60	do	
Wilson		43	17.55		20	45.57	do	
	42°-43°			72°-73°				
Chesterfield	42	53	23.15	72	26	23.11	do	
Halifax		46	30.79		43	27.67	C. & G. S	
Haystack		54	50.09		55	10.55	do	
White Hill		59	17.68		48	18.61	do	

MASSACHUSETTS.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43.			70°-71°				
	°	′	″	°	′	″		
Abbott Rock, stone beacon	42	31	49.48	70	51	46.34	C. & G. S	Rept. '85.
Amesbury Mills, tall white spire		51	21.88		55	58.58	do	Do.
Andrew Point		40	58.98		37	46.80	do	Do.
Annisquam Harbor, light-house		39	43.02		40	55.29	do	Do.
Annisquam, pole on rock		39	26.92		40	39.62	do	Do.
Apple Island, flag		21	31.55		59	32.43	do	Do.
Atlantic House, chimney		16	03.02		50	53.05	do	Do.
Bailey Wharf		48	42.94		51	56.55	do	Do.
Baker Island, light-house		32	11.53		47	11.22	do	Do.
Baker Hill		14	35.94		54	28.47	do	Do.
Ballard		27	17.56		59	32.57	do	Do.
Barrel Beacon		19	22.27		55	09.18	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Bartlett	42	50	04.46	70	55	23.74	C. & G. S	Rept. '85.
Batt Hill		52	15.86		53	32.60	do	Do.
Beacon Hill, 1		36	24.94		38	43.01	do	Do.
Beacon Hill, 2		36	11.74		38	38.64	do	Do.
Beacon Hill, magnetic station		36	22.79		38	46.85	do	Do.
Belle Isle		22	57.30		59	56.35	do	Do.
Beverly:								
Powder house		33	12.60		52	33.13	do	Do.
Tall spire, with turrets		32	51.06		52	43.52	do	Do.
Beverly Point, flag in tree		32	59.04		54	15.46	do	Do.
Beverly rocks		33	58.78		50	14.98	do	Do.
Bluff Head, flag		22	03.82		58	04.53	do	Do.
Black Rock		16	08.56		49	28.42	do	Do.
Bolles		35	05.95		47	35.44	do	Do.
Bonney		03	10.50		52	34.01	do	Do.
Boston, light-house		19	40.74		53	28.18	do	Do.
Bowlder, west of Salem Turnpike		30	21.92		56	07.38	do	Do.
Bowditch Ledge, beacon		32	25.38		48	43.19	do	Do.
Brant		05	17.32		38	28.70	do	Do.
Breakwater, east end, spindle		37	27.31		17	34.06	do	Do.
Brookhouse House		29	08.56		53	13.76	do	Do.
Brown Hill		36	45.69		50	49.98	do	Do.
Bunkin Island, flag		16	51.86		54	02.85	do	Do.
Burnham Brown, flag		39	32.00		49	25.88	do	Do.
Butler Hill		39	29.50		40	18.33	do	Do.
Byfield church, square tower		44	19.04		55	53.81	do	Do.
Cape Ann, north light-house		38	21.25		34	31.05	do	Do.
Cape Ann, south light-house		38	12.82		34	31.78	do	Do.
Cape Cod, or Highlands of Truro, light-house.		02	23.16		03	39.83	do	Do.
Carolina Hill		06	58.52		43	52.85	do	Do.
Cat Hill		13	19.18		45	20.32	do	Do.
Cat Island:								
East rock		30	32.61		48	45.00	do	Do.
Flagstaff		30	43.52		48	55.42	do	Do.
Choate		39	55.52		45	40.80	do	Do.
Church spire, summer house		28	55.14		53	08.45	do	Do.
Clift		09	29.08		45	05.26	do	Do.
Coddon		30	59.17		51	17.52	do	Do.
Coney Island, flag		31	42.89		50	14.78	do	Do
Cohasset church		14	35.63		48	14.02	do	Do.
Crane Neck		46	13.67		58	31.75	do	Do.
Crow Point		15	41.98		53	46.47	do	Do.
Crusoe House, flagstaff		26	10.65		58	07.58	do	Do.
Danvers Insane Asylum, tower		34	51.74		58	30.82	do	Do.
Danvers New Mills, tall spire		33	20.70		55	30.55	do	Do.
Danvers Plain, tall spire		34	03.32		56	18.26	do	Do.
Deer Island		21	01.28		57	30.99	do	Do.
Beacon		20	23.44		57	18.41	do	Do.
Flag		21	01.24		57	30.95	do	Do.
Hospital cupola		21	12.39		57	53.15	do	Do.
Dexter Point		32	53.80		50	44.26	do	Do.
Derby Wharf, light-house		30	59.91		53	02.54	do	Do.
Dodge Hotel, cupola		32	02.86		53	49.30	do	Do.
Dogtown, Methodist church		38	04.86		40	33.09	do	Do.
Dread Ledge, beacon		27	23.19		53	43.54	do	Do.
Dummer Academy		45	16.29		53	59.58	do	Do.
Duxbury, astronomic station		02	55.18		40	10.96	do	Do.
Eagle Island		31	31.21		48	49.24	do	Do.
East Duxbury, belfry		02	08.10		40	24.05	do	Do.
Eastern Point, light-house		34	49.14		39	53.90	do	Do.
East Weymouth, church		12	50.40		55	31.08	do	Do.
Eaton Hill		15	44.08		59	53.43	do	Do.
Egg Rock		26	00.40		53	53.34	do	Do.
Light-house		26	00.76		53	54.02	do	Do.
Essex, powder house		38	19.16		47	18.24	do	Do.
Essex, red-top church		37	59.96		46	53.16	do	Do.
Fawn Beacon		21	17.58		56	32.87	do	Do.
Florence, Cosmian Hall clock tower		20	09.26		40	26.55	do	Do.
Folly Hill		33	59.12		54	48.20	do	Do.
Fort Lee		31	54.71		52	28.94	do	Do.
Fort Pickering, light-house		31	35.57		52	01.07	do	Do.
Fort Warren, west gable of house		19	13.10		55	42.40	do	Do.
Gallop Island, flag		19	37.30		56	21.48	do	Do.
Gallop Island, 2		19	37.97		56	23.16	do	Do.
George Island		19	11.16		55	42.32	do	Do.
Gloucester:								
Church		37	00.46		39	25.66	do	Do.
Universalist church		36	47.66		40	00.14	do	Do.
Grape Island, flag		16	07.28		55	27.21	do	Do.
Graves		21	53.66		52	12.61	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Great Aquavitæ	42	31	34.58	70	51	28.24	C. & G. S	Rept. '85.
Great Brewster		20	01.96		53	45.18	do	Do.
Great Brewster, 2		20	01.68		53	45.22	do	Do.
Great Haste		32	05.29		50	32.51	do	Do.
Great Misery, flag		32	50.20		47	49.23	do	Do.
Great Quincy		16	29.03		57	06.87	do	Do.
Green Island, flag		21	11.17		53	33.01	do	Do.
Green Island, 2		21	11.14		53	33.02	do	Do.
Grose		09	53.90		52	43.52	do	Do.
Grover Cliff		23	22.79		58	08.65	do	Do.
Gurnet		00	11.40		36	06.05	do	Do.
Gurnet, light-house		00	12.30		36	04.03	do	Do.
Halfway Rock, beacon		30	09.38		46	31.40	do	Do.
Hangman Ledge, beacon		17	44.75		57	39.22	do	Do.
Hardy Rock, beacon		32	11.36		48	01.62	do	Do.
Hatch		08	08.48		42	11.36	do	Do.
Hayden's Hotel		15	10.37		46	20.13	do	Do.
Highland		01	41.33		02	47.49	do	Do.
Hingham:								
Church with clock		14	34.32		53	29.43	do	Do.
Great Plains church		12	38.35		53	04.50	do	Do.
Old Colony house, cupola		14	51.75		52	22.62	do	Do.
Old church		14	26.68		53	14.96	do	Do.
Hull:								
Oregon House, cupola		18	12.14		54	47.44	do	Do.
Steamboat Hotel, cupola		18	16.26		55	08.29	do	Do.
Hospital Point, light-house		32	47.60		51	23.29	do	Do.
Indian Hill, flagstaff		47	03.22		56	54.40	do	Do.
Ipswich:								
Beacon		41	07.56		45	59.91	do	Do.
Light-house		41	06.81		46	07.32	do	Do.
Tall dark spire		40	53.18		50	11.70	do	Do.
Town farm		43	03.92		50	52.09	do	Do.
Jones		09	28.84		50	01.88	do	Do.
Kettle Island		34	01.26		43	22.00	do	Do.
Kimball's house, center chimney		20	19.12		53	26.75	do	Do.
King Oak Hill, pole		13	38.94		56	25.32	do	Do.
Lane Cove, white spire		40	41.55		39	15.88	do	Do.
Legg Hill		29	23.30		53	30.83	do	Do.
Lewis		08	09.45		43	13.69	do	Do.
Little Aquavitæ, pole		31	34.78		51	13.10	do	Do.
Little Haste, beacon		32	07.71		50	35.95	do	Do.
Little Nahant		26	13.27		55	52.09	do	Do.
Little Oldtown		46	24.87		50	32.24	do	Do.
Londoner Beacon		38	06.26		33	59.33	do	Do.
Long Island Head, light-house		19	48.13		57	24.12	do	Do.
Long Island Hotel, cupola		19	27.40		57	53.39	do	Do.
Long Island, south end		18	39.52		58	37.16	do	Do.
Long Island, south end, 2		18	39.60		58	36.88	do	Do.
Long Point:								
Light-house		01	59.47		10	09.01	do	Do.
Schoolhouse		01	21.71		10	55.15	do	Do.
Lovell Island		19	48.60		55	50.36	do	Do.
Lufkin Hill		38	16.08		44	40.86	do	Do.
Lynn, east church, green tower		28	07.12		56	16.41	do	Do.
Lynn:							do	Do.
High rock		28	04.96		56	52.10	do	Do.
West church turret		27	45.71		57	37.00	do	Do.
Manchester, church, with dark spire		34	30.28		46	20.82	do	Do.
Manning Hill		42	30.26		48	23.32	do	Do.
Marblehead:								
Black-top church		30	25.66		50	54.11	do	Do.
Light-house		30	19.76		50	03.02	do	Do.
Neck		29	46.94		50	29.04	do	Do.
Rock, beacon		30	11.95		49	34.48	do	Do.
Marshfield cupola		09	25.12		44	33.34	do	Do.
Milk Island		37	41.64		35	31.80	do	Do.
Minot Ledge light-house		16	11.16		45	34.71	do	Do.
Moonhead, 1		18	22.20		59	23.06	do	Do.
Moonhead, 2		18	22.04		59	23.13	do	Do.
Morrill		49	15.65		51	06.50	do	Do.
Mouth of Merrimac, chimney of house		49	13.63		49	18.14	do	Do.
Mount Hope		11	34.97		49	18.00	do	Do.
Nahant, hotel cupola		25	09.20		54	19.84	do	Do.
Nantasket		18	15.69		54	20.20	do	Do.
Nantucket Cliff, range beacon		17	37.96		06	24.12	do	Do.
Newbury:								
Belleville church		49	06.77		53	24.84	do	Do.
Upper green church		47	58.56		51	46.19	do	Do.
Newburyport:								
Academy		48	31.79		52	28.89	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Newburyport—Continued.								
Beacon on north pier	42	48	49.26	70	51	28.43	C. & G. S.	Rept. '85.
Federal Street church		48	30.56		51	59.57	do	Do.
Harris Street church		48	31.71		52	23.74	do	Do.
Newburyport light-house		48	54.76		49	10.42	do	Do.
Newburyport Unitarian church		48	33.42		52	19.21	do	Do.
Neptune House, flagstaff		25	43.48		58	46.76	do	Do.
Nix's Mate		19	53.35		56	40.94	do	Do.
North Gooseberry Island		31	35.97		47	39.19	do	Do.
North Marshfield Unitarian church spire.		08	30.15		44	29.46	do	Do.
North Pettick Island		18	06.28		55	47.57	do	Do.
North Pettick Island, 2		18	06.32		55	47.73	do	Do.
North Weymouth, church		13	46.46		56	42.94	do	Do.
Ocean House, cupola		28	53.73		52	33.64	do	Do.
Oldtown		46	07.58		51	00.90	do	Do.
Oldtown church spire		47	58.49		51	46.19	do	Do.
Orne		30	10.26		57	54.45	do	Do.
Outer Brewster, 2		20	29.38		52	41.21	do	Do.
Ox Pasture Hill		44	17.08		52	55.00	do	Do.
Paine Hill, observatory		14	01.56		59	42.96	do	Do.
Parker Hill		13	45.60		46	49.55	do	Do.
Pamet		00	14.91		04	52.68	do	Do.
Pig Rock beacon		16	44.04		56	22.65	do	Do.
Pincin Hill		11	21.07		46	45.42	do	Do.
Plum Island, 1		46	37.02		48	17.72	do	Do.
Plum Island, 2		44	27.80		47	33.78	do	Do.
Plum Island magnetic station		47	59.94		48	49.34	do	Do.
Plymouth light-house		00	12.30		36	04.08	do	Do.
Point Allerton beacon		18	47.08		53	00.29	do	Do.
Point Allerton flag		18	37.12		52	59.36	do	Do.
Point Shirley, foundry chimney		21	31.80		58	20.22	do	Do.
Poole Hill		39	24.69		38	05.77	do	Do.
Powow		51	57.01		56	18.81	do	Do.
Powder Point		02	49.15		39	10.75	do	Do.
Prospect:								
Hingham		11	34.69		51	27.16	do	Do.
Rowley		42	19.15		53	33.18	do	Do.
Provincetown		03	08.45		11	20.53	do	Do.
Academy		03	09.78		11	14.50	do	Do.
Baptist church belfry		03	27.45		10	39.74	do	Do.
Methodist church belfry		03	06.52		11	17.82	do	Do.
Methodist Centenary church		02	52.44		11	26.78	do	Do.
New Universalist church spire		03	02.08		11	19.94	do	Do.
Orthodox church spire		03	04.08		11	17.61	do	Do.
Schoolhouse		02	41.17		11	36.90	do	Do.
Quincy:								
Bent Point church		14	45.75		58	31.97	do	Do.
Black-top church		15	00.66		59	49.90	do	Do.
Race		04	50.41		12	26.65	do	Do.
Race Point light-house		03	44.56		14	36.99	do	Do.
Railcut Hill		37	42.87		38	58.40	do	Do.
Rainsford Island:								
Flag		18	46.91		57	07.12	do	Do.
Flagstaff		18	46.83		57	07.41	do	Do.
Rockland church		07	48.98		54	56.63	do	Do.
Rockland House, cupola		15	56.90		51	10.05	do	Do.
Rockport, red-top church		39	28.80		37	09.70	do	Do.
Rowley:								
Church spire with turrets		42	59.02		52	42.38	do	Do.
Marsh		44	37.76		50	16.33	do	Do.
Sagamore Head		16	24.46		51	50.04	do	Do.
Salem:								
South church, corner Cambridge and Chesnut streets.		31	12.02		53	59.36	do	Do.
Howard street church		31	28.12		53	34.04	do	Do.
Salisbury church		50	33.98		51	38.96	do	Do.
Salisbury Beach		50	49.10		49	03.44	do	Do.
Salisbury Marsh		52	18.68		49	14.68	do	Do.
Salt Island, flag		37	11.38		37	26.60	do	Do.
Salvage		40	20.24		34	05.94	do	Do.
Scituate		14	14.65		49	51.23	do	Do.
Light-house		12	17.32		42	58.74	do	Do.
Unitarian church		12	00.69		45	22.19	do	Do.
South Abington		04	49.67		56	34.24	do	Do.
South Danvers, tall spire		31	35.38		55	40.55	do	Do.
South Pettick Island		17	23.82		56	51.66	do	Do.
Spectacle Island, flag		19	38.90		59	16.66	do	Do.
Sprague		00	17.90		58	00.11	do	Do.
Standish		00	50.77		40	58.21	do	Do.
Monument		00	50.24		40	57.66	do	Do.
Stout		04	09.52		07	32.83	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Straitsmouth light-house	42	39	44.37	70	35	19.15	C. & G. S	Rept. '85.
Strawberry Hill, barn		17	22.52		52	49.47	do	Do.
Studley		08	13.49		48	07.38	do	Do.
Summerhouse on high rock		28	05.06		56	48.86	do	Do.
Swampscott, church		28	06.14		54	58.40	do	Do.
Ten Pound Island light-house		36	06.66		39	57.58	do	Do.
Thatcher Island		38	10.94		34	46.28	do	Do.
Thayer Hill, yellow house chimney		13	51.49		58	10.55	do	Do.
Thompson		36	41.92		43	49.16	do	Do.
Tinker Island, pole on house		28	57.71		50	07.28	do	Do.
Turkey Hill		14	25.68		51	14.22	do	Do.
Twopenny Loaf, flag		39	36.80		43	08.84	do	Do.
Upper Harbor, inner beacon		48	40.70		51	59.70	do	Do.
Do		48	41.70		51	55.25	do	Do.
Ware Hill, flagstaff		30	40.60		54	32.79	do	Do.
Webster (Hon. D.):								
West chimney on house		03	48.26		40	47.07	do	Do.
Flagstaff		04	39.21		40	13.77	do	Do.
Weeks, house chimney		20	21.21		53	49.02	do	Do.
West Duxbury, Unitarian church steeple.		02	06.65		41	33.44	do	Do.
West Salisbury:								
Powderhouse		51	22.08		54	51.36	do	Do.
Church		50	39.64		55	01.21	do	Do.
West Scituate, church		09	28.83		51	10.23	do	Do.
Weymouth Great Hill		14	59.38		56	33.50	do	Do.
White		07	05.94		41	24.59	do	Do.
White Hill		12	52.47		58	39.30	do	Do.
Winthrop Head		22	04.07		58	06.04	do	Do.
Winthrop Head, 2		22	04.86		58	06.25	do	Do.
Wood End light-house		01	16.61		11	38.49	do	Do.
Woods Hotel		45	23.87		48	15.60	do	Do.
Woodward Hill, flag		36	59.74		42	05.96	do	Do.
	42°-43°			71°-72°				
Adams School, flagstaff	42	21	57.86	71	01	59.08	do	Do.
Agassiz Museum		22	44.52		06	56.04	do	Do.
Alum Pond		01	14.51		45	45.24	do	Do.
Ashland		16	37.41		06	52.84	do	Do.
Asnebumskit		18	05.11		53	50.81	do	Do.
Bald Hill		02	44.22		42	35.59	do	Do.
Battery Wharf		22	01.82		02	59.22	do	Do.
Bay State Iron Works		20	24.77		02	22.31	do	Do.
Bay State Steam Engine Works		21	45.52		02	09.69	do	Do.
Bell Tower		17	50.78		06	30.83	do	Do.
Bird Island		21	22.80		01	15.97	do	Do.
Beacon		21	18.06		01	15.96	do	Do.
Blind Asylum		20	07.04		02	32.86	do	Do.
Blue Hill		12	43.68		06	52.71	do	Do.
Boston:								
State prison cupola		22	28.23		04	08.84	do	Do.
Berkley street, yellow spire		20	44.13		04	15.42	do	Do.
Hanover street, brick church		21	49.90		03	17.44	do	Do.
Hollis street church		20	59.42		03	53.15	do	Do.
Jail, cupola		21	43.26		04	14.44	do	Do.
Catholic cathedral statue		20	12.67		04	25.14	do	Do.
Neck, dark spire with cross		20	26.77		04	25.27	do	Do.
St. Mary's church, north spire		21	54.82		03	29.69	do	Do.
State House		21	29.59		03	51.04	do	Do.
Boxboro		29	29.94		31	39.96	G. S	Bull. 122.
Boylston School, cupola		21	21.51		03	09.02	C. & G. S	Rept. '85.
Breed Island		23	28.04		00	30.28	do	Do.
Brick factory		23	45.12		04	12.89	do	Do.
Near Mystic River. cupola		24	32.76		05	27.07	do	Do.
Brighton:								
East church		20	57.83		09	13.08	do	Do.
West church, with clock		20	56.25		09	20.29	do	Do.
Brookline, Dr. Pierce's church		19	38.18		07	52.48	do	Do.
Brown Hill		37	00.54		50	41.31	G. S	Bull. 122.
Bunker Hill:								
Catholic church		22	53.34		04	00.70	C. & G. S	Rept. '85.
Monument		22	35.05		03	40.56	do	Do.
Burnt Swamp		01	08.36		22	54.53	do	Do.
Cambridge.								
Baptist church		22	34.42		07	07.71	do	Do.
Gas works chimney		22	24.35		07	36.78	do	Do.
Observatory, center of dome		22	53.49		07	43.88	do	Do.
Observatory, meridian mark		25	47.43		07	43.52	do	Do.
Observatory, west transit		22	53.48		07	44.48	do	Do.
Unitarian church		22	28.70		07	10.78	do	Do.
Cambridgeport:								
Flagstaff near engine house		21	45.58		05	15.64	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
	°	′	″	°	′	″		
Cambridgeport—Continued.								
Observatory dome	42	21	19.06	71	06	35.85	C. & G. S	Rept. '85.
Redoubt, flagstaff		21	23.89		06	17.21	do	Do.
Universalist church		21	47.52		06	00.88	do	Do.
Captain John's Hill		16	15.67		07	47.00	do	Do.
Carpet-cleaning factory		21	16.62		04	39.93	do	Do.
Castle Island		20	19.26		00	45.65	do	Do.
Center		21	09.74		02	46.38	do	Do.
Central Wharf cupola		21	32.54		03	05.21	do	Do.
Chelsea:								
Bridge		22	56.55		02	55.67	do	Do.
Brown tower		23	28.98		01	46.40	do	Do.
Church		24	32.98		00	26.28	do	Do.
Dark spire cross		23	40.47		01	54.68	do	Do.
Tall dark spire		23	30.56		02	16.90	do	Do.
White spire, martin hole windows		23	24.55		02	19.91	do	Do.
White spire, three tiers windows		23	36.20		02	16.13	do	Do.
White spire, with clock		23	27.33		02	18.18	do	Do.
Chandler Hill		16	15.20		47	11.43	do	Do.
Charles River tripod		21	09.41		07	00.28	do	Do.
Charlestown, brick church cross		22	21.96		03	48.32	do	Do.
Cloverdon		22	47.54		07	18.42	do	Do.
Observatory (zenith telescope)		22	46.29		07	17.60	do	Do.
Coal shed, flagstaff		23	06.56		02	39.20	do	Do.
Commercial Point, wharf, flag		18	00.28		02	38.24	do	Do.
Corey		20	33.38		08	02.20	do	Do.
Cunard Wharf, flagstaff		21	49.98		02	27.98	do	Do.
Dorchester:								
Church, with clock		18	29.60		03	45.81	do	Do.
Dr. Codman's church		17	26.85		04	18.00	do	Do.
Heights		20	03.43		02	35.91	do	Do.
East Boston		22	53.13		02	11.74	do	Do.
Brick church, dark spire		22	26.77		02	21.89	do	Do.
Dry dock, post		21	44.76		01	54.81	do	Do.
Elevator		21	47.59		02	15.51	do	Do.
Granite church, dark spire		22	16.06		02	28.44	do	Do.
Iron works, chimney		22	55.76		01	48.44	do	Do.
Point, flag		21	58.24		01	44.75	do	Do.
Reservoir, 2		22	52.56		02	09.91	do	Do.
Shipyard, east wharf, post		21	50.12		01	41.59	do	Do.
Eastern avenue, wharf, post		21	50.10		02	56.18	do	Do.
East Cambridge:								
Church near court-house		22	11.46		04	50.78	do	Do.
Court-house, cupola		22	11.95		04	48.56	do	Do.
Edgeworth Mills (round chimney)		25	01.38		04	30.87	do	Do.
Faneuil Hall		21	36.38		03	23.70	do	Do.
Farm schoolhouse, southeast gable		19	05.26		00	27.55	do	Do.
Fay Mountain		14	23.79		37	42.54	G. S	Bull. 122.
Fitchburg:								
Depot		22	00.36		03	41.64	C. & G. S	Rept. '85.
Roundhouse		22	23.43		04	10.02	do	Do.
Flagstaff, corner Dorchester street and turnpike.		19	47.62		03	26.50	do	Do.
Forbes		15	27.87		01	38.94	do	Do.
Fort Hill, wharf, post		21	15.74		03	05.16	do	Do.
Fort Independence, flagstaff		20	18.90		00	44.92	do	Do.
Foster Wharf, post		21	21.15		03	01.36	do	Do.
Foxboro:								
Baptist church, white spire		03	51.18		15	05.06	do	Do.
Orthodox church, dark spire		03	54.65		15	08.34	do	Do.
Fulton Wire Works, south chimney		20	08.04		03	29.56	do	Do.
Gambrel, roof, northeast gable		22	18.38		03	26.45		
Gas works:							do	Do.
Near Malden Bridge		23	18.75		04	29.70	do	Do.
North end of Boston		22	01.90		03	28.38	do	Do
Ventilator		20	50.28		03	27.18	do	Do.
Glass works, east gable		22	22.65		04	41.86	do	Do.
Governors Island		21	08.31		00	39.08	do	Do.
Governors Island, 2		21	09.10		00	42.86	do	Do.
Governors Island, 3		21	08.84		00	41.12	do	Do.
Grand Junction, wharf		21	47.39		02	22.93	do	Do.
Grays Wharf, long brick building		22	09.48		03	16.38	do	Do.
Groton Hill		36	38.28		33	28.31	G. S	Bull. 122.
Guide post, west end of milldam		20	55.63		05	51.00	C. & G. S	Rept. '85.
High service		19	31.35		05	42.30	do	Do.
Hog Island tripod		23	30.16		00	39.69	do	Do.
Holmes factory		22	45.76		03	29.36	do	Do.
Holt		38	28.03		06	24.87	do	Do.
House on hill		34	51.96		59	02.35	G. S	Bull. 122.
Hyde Park Catholic church		15	18.56		07	23.15	C. & G. S	Do.
India wharf:								
Cupola		21	29.10		02	59.70	do	Rept. '85.
Post		21	28.04		02	59.09	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
	°	′	″	°	′	″		
Iron smokestack	42	23	14.06	71	02	26.10	C. & G. S	Rept. '85.
James and Pope's timber dock		20	32.51		02	39.68	do	Do.
Jerusalem		15	20.73		08	49.00	do	Do.
Jewish cemetery		15	35.37		09	15.07	do	Do.
Joe Rock		01	52.99		24	17.24	do	Do.
Lawrence School, cupola		20	28.78		08	12.88	do	Do.
Lewis Wharf, cupola		21	47.44		03	00.02	do	Do.
Lincoln Wharf, post		21	57.72		02	58.15	do	Do.
Long Wharf		21	37.65		02	53.75	do	Do.
Building, lightning rod		21	37.08		02	57.46	do	Do.
2. post		21	36.45		02	53.54	do	Do.
Loring's machine-shop wharf		20	31.60		02	02.70	do	Do.
Lowell:								
Depot, flagstaff		21	53.81		03	47.12	do	Do.
Draw, flagstaff		22	05.14		04	08.40	do	Do.
Roundhouse		22	09.74		04	23.39	do	Do.
Machine shop, tall chimney, on ridge-pole.		20	28.60		08	59.10	do	Do.
Malden:								
Bridge		23	11.41		04	13.50	do	Do.
Bridge, yellow house, chimney at tall gable.		23	34.58		04	09.58	do	Do.
Church, tall spire		25	38.84		04	01.56	do	Do.
Yellow spire		25	38.75		04	01.44	do	Do.
Mansfield, old Unitarian Church		01	23.43		13	04.03	do	Do.
Marine Hospital, flagstaff		23	21.22		02	43.70	do	Do.
Massachusetts north base		03	06.59		12	24.87	do	Do.
McLean Asylum, north dome		22	37.26		04	54.68	do	Do.
Medford:								
Tall square chimney near Malden bridge.		24	52.20		06	31.54	do	Do.
Unitarian church		25	13.97		06	56.23	do	Do.
Milldam:								
Regatta house flagstaff		21	04.89		05	19.01	do	Do.
Yellow house, chimney		20	56.22		05	51.67	do	Do.
Miller River, head of church		22	44.08		05	48.79	do	Do.
Milton:								
Church		15	12.35		04	50.38	do	Do.
Old church		15	12.35		04	50.38	do	Do.
Mills, tall church spire		16	26.49		04	07.96	do	Do.
Mount Auburn		22	10.94		08	40.37	do	Do.
Mount Daniel		01	41.54		48	10.30	do	Do.
Mugget		08	02.12		57	28.24	do	Do.
National dock building		22	02.92		02	33.56	do	Do.
Naval Hospital		23	22.58		02	55.94	do	Do.
Navy-Yard:								
Battery		22	23.97		03	06.32	do	Do.
Chimney		22	30.04		03	09.16	do	Do.
Nealys House		21	22.37		06	27.13	do	Do.
Neponset church		17	11.62		07	52.87	do	Do.
New England Glass Company, chimney.		22	21.35		04	40.31	do	Do.
North Brighton, dark spire		21	13.69		08	12.35	do	Do.
Northeast corner of Connecticut		01	24.82		48	04.20	do	Do.
Northwest corner of Rhode Island		00	29.15		47	58.92	do	Do.
Observatory		25	53.23		37	37.19	G. S	Bull. 122,
Octagonal building		21	37.37		04	19.02	C. & G. S	Rept. '85.
One-story red building		22	07.93		04	17.38	do	Do.
Organ factory		21	44.45		04	58.17	do	Do.
Outer Brewster		20	29.40		52	41.16	do	Do.
Otter street		21	21.48		04	24.90	do	Do.
Peck's chimney		22	51.09		03	03.64	do	Do.
Pepperell		42	12.64		35	12.59	do	Do.
Petty Rock		16	16.05		06	49.62	do	Do.
Planing mill, chimney		22	16.17		07	17.17	do	Do.
Point Curve		21	14.02		02	56.28	do	Do.
Poplar Hill, stone monument		44	11.56		15	20.30	do	Do.
Powderhorn		24	04.68		01	52.01	do	Do.
Powderhorn, 2		24	04.56		01	52.05	do	Do.
Powers and Melville's elevator		22	59.03		04	40.01	do	Do.
Prentice coal wharf, post		21	06.76		03	11.58	do	Do.
Prospect:								
Somerville		22	54.62		05	37.88	do	Do.
Waltham		23	18.83		15	15.33	do	Do.
Quincy, stone church		15	04.25		00	12.98	do	Do.
Red Brush		01	49.55		22	23.46	do	Do.
Reservoir		20	47.50		34	05.96	G. S	Bull. 122.
Riverside Press, chimney		21	46.03		06	57.05	C. & G. S	Rept. '85.
Roxbury:								
Dr. Putnam's church		19	47.81		05	24.96	do	Do.
Laboratory, chimney		19	24.52		05	52.98	do	Do.
Tall spire in Jamaica Plains		18	36.44		06	59.36	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
Roxbury—Continued.	°	′	″	°	′	″		
New Unitarian church	42	19	42.11	71	04	51.72	C. & G. S	Rept. '85.
Oil works, chimney		19	55.40		03	55.14	do	Do.
Sailors' Home, cupola		21	19.10		03	03.40	do	Do.
Sargent's Observatory		18	42.75		05	41.40	do	Do.
South Bay, tripod		19	31.09		03	46.58	do	Do.
Somerville:								
Church near Malden bridge		23	07.43		04	36.63	do	Do.
Church on hill		23	12.18		05	52.87	do	Do.
Red church		23	11.98		05	52.46	do	Do.
South Boston:								
Dark spire, cross		20	31.87		03	24.44	do	Do.
Point		20	13.02		01	38.45	do	Do.
Reservoir		19	58.48		02	46.56	do	Do.
Sea wall		21	18.40		02	43.48	do	Do.
Squantum		18	13.89		00	41.57	do	Do.
Standard sugar refinery		20	44.00		03	15.58	do	Do.
Stone powder house		24	00.40		07	00.17	do	Do.
Suffolk cordage factory, ball		19	38.04		04	20.24	do	Do.
Sumner		15	21.05		09	32.22	do	Do.
Ten Hill farm, flag		23	50.88		05	15.26	do	Do.
Thompson Island:								
Flag		19	14.60		00	16.12	do	Do.
Pole near farm school		19	07.56		00	26.01	do	Do.
Town Hill		38	15.54		59	05.89	G. S	Bull. 122.
Tudor, cupola		22	14.98		03	39.81	C. & G. S	Rept. '85.
Tuft College		24	26.84		07	13.85	do	Do.
Turkey Hill		35	28.03		42	41.63	G. S	Bull. 122.
Varnish factory, chimney		21	49.54		07	06.33	C. & G. S	Rept. '85.
Wachusett:								
Chimney		29	21.28		53	15.13	G. S	Bull. 122.
C. & G. S. station		29	20.78		53	13.98	do	Do.
Waite, 1		26	00.83		03	57.96	C. & G. S	Rept. '85.
Waite, 2		26	20.43		01	13.14	do	Do.
Watortown Arsenal		21	42.72		09	45.97	do	Do.
Watatick:								
C. & G. S. station		41	48.55		53	34.87	G. S	Bull. 122.
State line		42	40.93		53	55.73	C. & G. S	Rept. '85.
Tree		41	48.47		53	34.40	G. S	Bull. 122.
Waverly House		22	17.56		03	46.42	C. & G. S	Rept. '85.
Wellington Hill		16	59.24		05	44.08	do	Do.
West Boston bridge, pole on draw		21	41.49		04	26.12	do	Do.
West Cambridge, tall spire with clock		24	55.63		09	15.82	do	Do.
Winnisimet, church with clock		23	27.35		02	18.18	do	Do.
Winslow's factory, corner		23	02.22		03	53.96	do	Do.
	42°-43°			72°-73°				
Amherst	42	22	15.30	72	31	07.00	do	Do.
Agricultural College belfry		23	26.31		31	46.50	do	Do.
Agricultural College drill-hall tower.		23	17.06		31	43.56	do	Do.
Agricultural College flagstaff		23	21.69		31	42.64	do	Do.
City, Methodist church tower		24	50.34		30	32.79	do	Do.
College Hall		22	22.02		31	14.42	do	Do.
Congregational church spire		22	32.07		31	00.60	do	Do.
Episcopal church spire		22	29.76		31	09.06	do	Do.
Lawrence Observatory		22	17.06		31	10.05	do	Do.
Walker Hall tower		22	18.21		31	02.82	do	Do.
Williston Hall tower		22	17.76		31	06.59	do	Do.
Battlecock		23	02.70		46	25.40	do	Do.
Belchertown:								
Baptist church tower		16	40.81		24	04.66	do	Do.
First Congregational church spire.		16	42.68		24	05.98	do	Do.
High School tower		16	37.90		24	11.95	do	Do.
Methodist church tower		16	42.12		24	10.26	do	Do.
Boundary Rock		01	53.84		16	18.42	do	Do.
Brush		09	03.89		39	39.62	do	Do.
Chestnut Hill		24	34.30		39	40.10	do	Do.
Chicopee:								
French Catholic church spire		08	49.11		35	34.15	do	Do.
Catholic church spire		08	40.26		36	20.25	do	Do.
Skating rink spire		08	50.25		36	36.77	do	Do.
Chicopee Falls:								
Congregational spire		09	25.06		34	51.70	do	Do.
Catholic church spire		09	42.82		34	51.06	do	Do.
Methodist church spire		09	25.50		35	00.37	do	Do.
New Baptist church spire		09	26.08		34	54.10	do	Do.
Town Hall spire		08	54 65		36	25.94	do	Do.
Colonel Mountain		14	09.35		13	58.35	do	Do.
Connecticut line, signal (Borden)		01	55.98		20	46.14	do	Do.
Connecticut River Lumber Co., chimney.		17	29.65		37	14.30	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			72°-73°				
	°	′	″	°	′	″		
Conway Township, southeast corner	42	27	30.25	72	39	28.34	C. & G. S	Rept. '85.
Craft		12	46.51		38	20.46	do	Do.
Dickinson, flag in tree		25	31.50		30	26.60	do	Do.
Dolbar Hill		32	45.62		03	30.40	G. S	Bull. 122.
East bench mark		12	53.96		36	10.22	C. & G. S	Rept. '85.
Easthampton:								
First Congregational church spire.		16	20.74		40	17.24	do	Do.
Methodist church spire		16	15.79		40	22.28	do	Do.
Payson Congregational church spire.		16	12.02		40	22.78	do	Do.
Williston, Knight & Co., chimney		16	00.90		40	11.40	do	Do.
Williston Mills, tower		16	27.69		39	33.42	do	Do.
Williston Seminary gymnasium, tower.		16	13.85		40	16.00	do	Do.
Town Hall, tower		16	16.66		40	21.85	do	Do.
East Longmeadow, Congregational spire.		03	51.49		30	45.62	do	Do.
East tidal bench mark		12	53.95		36	10.40	do	Do.
Facing Rock		13	03.84		27	35.00	do	Do.
Feeding Hills		03	52.20		40	53.75	do	Do.
Congregational spire		04	04.15		40	45.48	do	Do.
Methodist spire		03	58.94		40	44.54	do	Do.
Florence:								
Methodist church spire		20	07.10		40	25.20	do	Do.
Engine-house tower		20	04.50		40	19.40	do	Do.
Catholic church spire		19	56.78		40	07.03	do	Do.
Congregational church spire		19	54.16		40	30.00	do	Do.
Manufacturing Co.'s mill, tower		19	53.57		40	44.64	do	Do.
School-house tower		19	51.98		40	33.41	do	Do.
Granby, Congregational church spire		15	22.87		31	04.12	do	Do.
Hadley:								
First Congregational church spire		20	30.88		35	20.81	do	Do.
Second Congregational church spire.		20	33.90		35	47.72	do	Do.
Hatchet		01	39.60		04	46.74	do	Do.
Hatfield:							do	Do.
Congregational church spire		22	13.68		35	50.97	do	Do.
Smith Academy, tower		22	15.68		35	44.70	do	Do.
Hawes Hill		27	26.43		07	07.18	do	Do.
Haydensville:								
Catholic church spire		22	22.87		41	53.70	do	Do.
Congregational church spire		21	15.34		41	39.08	do	Do.
High Ridge Hill		26	55.14		43	06.66	do	Do.
Hilliard Knob		18	20.23		30	38.37	do	Do.
Hitchcock		05	07.39		15	35.43	do	Do.
Holland House, chimney		05	05.04		42	14.89	do	Do.
Holyoke:								
City Hall tower		12	24.32		30	28.10	do	Do.
Engine-house tower		12	46.50		37	31.98	do	Do.
First Congregational belfry		12	41.16		37	49.36	do	Do.
Windsor Hotel tower		12	23.07		36	22.72	do	Do.
St. Jerome's Catholic spire		12	34.10		36	31.76	do	Do.
Second Baptist tower		12	24.78		36	48.58	do	Do.
Second Congregational tower		12	18.36		36	39.50	do	Do.
Indian Orchard, church spire		09	32.02		30	07.04	do	Do.
Jenksville, church tower		09	31.91		29	06.70	do	Do.
Jenksville, church tower, 2		09	30.19		28	58.94	do	Do.
Ludlow, Methodist tower		11	29.10		27	09.72	do	Do.
Leverett, Congregational church spire.		27	07.80		30	06.90	do	Do.
Longmeadow, Congregational church spire.		03	00.83		34	56.24	do	Do.
McCarthy		04	13.05		30	17.18	do	Do.
Mount Esther		27	10.19		39	54.64	do	Do.
Mount Holyoke Hotel, flagstaff		18	02.10		35	17.70	do	Do.
Mount Lincoln		21	49.38		25	24.53	do	Do.
Mount Toby		29	16.32		32	16.28	do	Do.
Mount Tom		14	30.80		38	55.06	do	Do.
Mount Warner		22	48.40		34	22.20	do	Do.
New Braintree, Congregational church spire		19	01.16		07	35.90	do	Do.
Nonotuck Hotel, tower		16	47.86		37	15.20	do	Do.
North Amherst, Congregational church spire.		24	36.74		31	52.29	do	Do.
North Base		28	46.15		36	43.57	do	Do.
North Hadley, Congregational church spire.		23	19.70		34	52.10	do	Do.
Northampton:								
Lunatic Asylum tower		18	52.16		38	51.00	do	Do.
Catholic church tower		19	33.61		38	02.98	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			72°-73°				
	°	′	″	°	′	″		
Northampton—Continued.								
Episcopal church tower	42	19	16.38	72	37	42.57	C. & G. S	Rept. '85.
First Congregational church spire		19	09.25		37	53.14	do	Do.
Methodist church spire		19	10.72		37	59.58	do	Do.
Round Hill flagstaff		19	27.53		38	22.38	do	Do.
Second Congregational church spire.		19	04.62		38	04.32	do	Do.
North Warner		22	56.00		34	17.90	do	Do.
Packard		27	40.64		21	11.09	do	Do.
Palmer, Universalist church spire		09	28.06		19	35.91	do	Do.
Peaked Mountain		02	50.94		20	26.20	do	Do.
Pelham, church spire		23	32.30		24	17.34	do	Do.
Rattle, flag in tree		01	59.08		24	28.67	do	Do.
Rattlesnake		01	59.58		24	28.60	do	Do.
Rock Rimmon		14	23.14		26	29.07	do	Do.
Secondary signal		02	23.04		54	07.82	do	Do.
Shingle Hill		23	23.30		41	59.50	do	Do.
Shutesbury:								
Congregational church spire		27	11.85		24	37.34	do	Do.
Baptist church spire		27	10.31		24	36.46	do	Do.
House, chimney		27	42.20		24	41.61	do	Do.
South Amherst, church spire		20	25.45		30	13.94	do	Do.
South Deerfield, Congregational church spire.		28	44.71		36	27.16	do	Do.
South Hadley, Congregational church spire.		15	31.59		34	31.26	do	Do.
South Hadley Falls:								
Catholic church spire		13	13.08		36	05.58	do	Do.
Congregational church spire		12	58.25		35	56.56	do	Do.
Methodist church spire		13	00.92		35	56.42	do	Do.
Female Seminary Observatory		15	21.78		34	40.88	do	Do.
Springfield:								
Arsenal, clock tower		06	26.48		34	54.70	do	Do.
Court-house tower		06	01.48		35	21.02	do	Do.
First Baptist church spire		06	10.88		35	04.19	do	Do.
Florence Street Methodist church spire.		06	01.11		34	06.72	do	Do.
Hope Congregational church tower.		06	38.69		33	55.63	do	Do.
North Congregational church spiro.		06	21.77		35	13.45	do	Do.
St. Joseph's Catholic church spire		06	06.63		35	10.64	do	Do.
South Congregational church spire.		06	08.04		35	00.10	do	Do.
St. Michael's church spire		06	15.20		35	05.10	do	Do.
State Street Methodist church spire.		06	19.18		34	53.36	do	Do.
Water-shops tower		05	51.94		33	50.44	do	Do.
Sugarloaf Hotel:								
South chimney		28	13.00		35	32.98	do	Do.
North chimney		28	13.30		35	33.08	do	Do.
Sunderland:								
Schoolhouse tower		28	02.32		34	44.74	do	Do.
Congregational church tower		27	57.91		34	49.70	do	Do.
Three Rivers, French Catholic church spire.		11	00.72		21	21.30	do	Do.
Tuft Hill		19	01.54		05	04.56	do	Do.
Two Tree		39	10.99		08	40.19	G. S	Bull. 122.
Ward Hill		34	12.13		10	24.85	do	Do.
Warwick (Borden)		43	21.57		19	14.26	C. & G. S	Rept. '85.
West bench mark		12	44.22		36	14.10	do	Do.
West Hampton, Congregational church spire.		18	16.57		46	32.39	do	Do.
West Springfield, First Congregational church spire.		06	52.18		37	31.94	do	Do.
Whately Congregational church spire		26	17.10		38	07.40	do	Do.
White, flag in tree		12	02.27		29	47.53	do	Do.
Wigwam		06	26.00		24	45.10	do	Do.
Wilbraham:								
Congregational church spire		07	16.48		25	54.87	do	Do.
Rich Hall, tower		07	27.68		25	55.10	do	Do.
	42°-43°			73°-74°				
Alander Mountain	42	05	15.06	73	30	18.72	do	Do.
Bald Peak		06	07.30		25	59.11	do	Do.
Brace Mountain		02	39.91		29	34.88	do	Do.
Corner stone, southwest corner of State.		02	58.38		29	15.96	do	Do.
Dome Peak		06	07.30		25	59.11	do	Do.
French Hill		25	38.46		02	16.44	do	Do.
Greylock		38	14.09		09	59.13	do	Do.
Iron Bolt		02	58.67		29	42.62	do	Do.
Perry Peak		25	15.65		22	48.78	do	Bull. 122.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	′	″	°	′	″		
Ryant Bush	42	03	04.05	73	28	56.63	C. & G. S	Bull. 122.
Washington spire		21	57.78		08	39.78	do	Do.
	41°-42°			69°-70°				
Basin	41	39	48.50	69	56	41.66	do	Rept. '85.
Camp		43	59.58		59	33.25	do	Do.
Chatham		41	50.70		58	48.38	do	Do.
Congregational church spire		40	58.54		57	41.72	do	Do.
Flagstaff		40	43.77		57	23.51	do	Do.
North light-house		40	18.28		57	01.27	do	Do.
South light-house		40	17.30		57	01.50	do	Do.
Spire		41	02.79		57	39.96	do	Do.
Cove		36	56.18		58	35.17	do	Do.
Crows Lookout		43	06.96		58	25.46	do	Do.
Cumming flagstaff		47	12.17		57	04.36	do	Do.
Eastham, Congregational church spire.		50	28.28		58	54.33	do	Do.
Eldridge		44	34.88		58	39.69	do	Do.
Harding Beach		39	31.55		59	03.16	do	Do.
Lombard Head		55	51.66		58	51.02	do	Do.
Marsh		43	51.92		55	39.55	do	Do.
Mayo		46	00.17		57	10.44	do	Do.
Monomoy		35	37.60		59	03.36	do	Do.
Light-house		33	33.78		59	39.02	do	Do.
Morris Island		39	29.48		57	34.14	do	Do.
Mosquito		39	26.91		57	32.60	do	Do.
Namequoit		45	26.74		57	42.48	do	Do.
Nauset:								
Beach		44	05.66		55	34.32	do	Do.
Center light-house		51	38.63		57	05.42	do	Do.
Harbor		47	22.72		56	46.80	do	Do.
Old Harbor		42	19.94		59	01.11	do	Do.
Orleans, Orthodox church spire		47	04.86		58	30.20	do	Do.
Pine		40	08.56		59	35.48	do	Do.
Pleasant Bay		44	34.89		58	39.64	do	Do.
Pochet		46	39.98		56	26.09	do	Do.
Sampson		45	21.74		57	00.43	do	Do.
Sankaty Head		16	59.91		57	53.41	do	Do.
Sankaty Head light-house		17	01.21		57	56.52	do	Do.
Shells		57	52.80		57	41.45	do	Do.
Sipson Island		44	00.28		57	52.03	do	Do.
South Wellfleet:								
Congregational church belfry		54	32.07		59	07.10	do	Do.
Methodist meetinghouse		54	24.54		59	07.72	do	Do.
Squam Head		19	33.48		59	56.05	do	Do.
Stage Harbor light-house		39	31.55		59	03.16	do	Do.
Strong		43	12.48		57	29.61	do	Do.
	41°-42°			70°-71°				
Aldin	41	49	48.33	70	57	02.79	do	Do.
Angelica Point		38	28.97		45	55.35	do	Do.
Atwood		45	11.39		04	24.31	do	Do.
Back River Harbor		43	18.58		36	50.49	do	Do.
Barnstable		41	48.82		18	25.58	do	Do.
West spire		41	54.89		23	03.28	do	Do.
Court-house		42	06.02		18	17.64	do	Do.
Light-house		43	21.16		16	53.34	do	Do.
Unitarian spire		42	02.46		17	57.67	do	Do.
Bass Hole		42	49.98		14	15.54	do	Do.
Bass River		38	38.44		12	12.13	do	Do.
Light-house		39	06.44		10	10.84	do	Do.
Billingsgate light-house		52	18.22		04	09.87	do	Do.
Bird Island light-house		40	00.65		43	01.14	do	Do.
Bishop and Clerks		34	27.44		15	01.96	do	Do.
Light-house		34	27.52		15	02.04	do	Do.
Blackfish Creek		54	28.86		01	04.80	do	Do.
Bluff (Nantucket)		17	31.40		06	26.77	do	Do.
Bourne Hill		44	00.82		29	11.63	do	Do.
Bowman Hill observatory		32	38.10		36	04.32	do	Do.
Bowman Point		32	36.46		36	05.84	do	Do.
Brant Point light-house		17	23.20		05	34.61	do	Do.
Brewster		46	12.76		04	46.46	do	Do.
Unitarian church spire		45	43.24		04	57.32	do	Do.
Cambria		59	14.88		00	45.13	do	Do.
Cape Poge		25	11.50		27	03.75	do	Do.
Light-house		25	16.03		27	05.70	do	Do.
Centerville church		38	44.94		20	49.27	do	Do.
Charles Neck		40	21.61		44	45.04	do	Do.
Clark Cove		15	20.47		10	43.16	do	Do.
Clark Point		35	34.15		54	03.69	do	Do.
Light-house		35	34.28		54	03.91	do	Do.
Coatue Point		19	06.62		02	57.07	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			70°-71°				
	°	′	″	°	′	″		
Coatue Point, 2	41	18	05.39	70	04	39.87	C. & G. S	Rept. '85.
Collier Ledge		35	48.36		21	06.69	do	Do.
Cotuit Neck		35	31.16		28	44.25	do	Do.
Cromeset Neck		43	41.74		43	20.57	do	Do.
Cuttyhunk		25	14.89		56	02.65	do	Do.
Light-house		24	52.36		57	00.18	do	Do.
Davis Hill		31	24.30		39	39.24	do	Do.
Davis Neck		32	54.42		33	48.63	do	Do.
Desert Hill		29	28.73		44	21.35	do	Do.
Dumpling Rock (Round Hill) light-house.		32	17.88		55	19.09	do	Do.
Duxbury Pier light-house		59	14.94		38	56.57	do	Do.
East Chop		28	04.80		33	50.91	do	Do.
Telegraph		28	04.72		33	49.00	do	Do.
Light-house		28	13.44		34	04.96	do	Do.
East Chop, 2		28	04.63		33	50.90	do	Do.
East Scargo (Borden)		44	00.87		10	16.39	do	Do.
East Plymouth		52	58.09		32	01.74	do	Do.
Eastham		49	26.09		00	14.92	do	Do.
Edgartown		23	51.77		32	55.96	do	Do.
Light-house		23	27.29		30	12.76	do	Do.
Spire		23	18.64		30	55.88	do	Do.
Eel River, steeple		56	15.18		37	49.12	do	Do.
Fair Haven, black spire		38	09.81		54	18.85	do	Do.
Falmouth		35	53.11		37	05.48	do	Do.
Spire		33	14.95		37	12.52	do	Do.
Fish-house, north gable		38	19.40		10	38.15	do	Do.
Folger, astronomic station		17	16.94		06	16.56	do	Do.
Forked Pond		14	15.94		01	03.65	do	Do.
Further Creek		16	39.72		14	06.85	do	Do.
Gay Head		20	50.30		50	13.96	do	Do.
Light-house		20	54.59		50	07.58	do	Do.
German Hill		41	27.96		12	35.96	do	Do.
Gibb Pond		16	53.65		01	31.46	do	Do.
Great Hill		42	33.28		43	20.44	do	Do.
Great Point (Nantucket) light-house		23	24.34		02	46.06	do	Do.
Great Rock, spindle		37	03.52		17	10.38	do	Do.
Griffin Island		56	14.37		04	06.05	do	Do.
Hamblin Hill		41	49.93		24	13.64	do	Do.
Hamblin Mound		56	14.18		02	47.46	do	Do.
Harwich belfry		41	12.39		04	35.97	do	Do.
Harwich Port		39	51.30		04	06.57	do	Do.
Herring Pond		20	47.35		31	34.16	do	Do.
Highland House, north tower		27	50.26		33	36.17	do	Do.
Hog Island Harbor		36	15.84		38	57.00	do	Do.
Holmes		55	26.56		32	39.02	do	Do.
Holmes Hole (or West Chop) light-house.		28	51.06		36	00.96	do	Do.
Holmes Hole		28	57.66		36	10.78	do	Do.
Holmes Hole, spire		27	15.15		36	20.18	do	Do.
Hopkins		46	02.05		02	51.54	do	Do.
Hyannis		37	53.34		18	26.67	do	Do.
West spire		39	05.77		17	15.21	do	Do.
Light-house		38	10.79		17	20.20	do	Do.
Universalist spire		39	14.38		16	56.08	do	Do.
Indian		25	46.74		40	40.70	do	Do.
Brook		51	30.36		00	23.41	do	Do.
Hill		52	58.13		32	01.75	do	Do.
Neck		43	33.27		41	27.05	do	Do.
Kingston		58	53.29		41	54.63	do	Do.
Kingston spire		59	36.08		43	52.77	do	Do.
Kotayma House, north tower		21	30.10		30	19.67	do	Do.
Long Neck		44	20.21		38	45.42	do	Do.
Mannerson		41	31.14		12	16.86	do	Do.
Manomet		55	38.70		35	28.13	do	Do.
Marston Mill		38	49.68		24	56.98	do	Do.
Mattapoisett, gray spire		39	43.93		49	12.28	do	Do.
Mattapoisett Neck		37	46.57		48	11.30	do	Do.
Mayo Beach light-house		55	49.82		02	05.66	do	Do.
Menauhant Hotel, west chimney		33	01.00		33	09.76	do	Do.
Menauhant Landing, flagstaff		32	59.68		33	08.92	do	Do.
Mendal (Borden)		42	03.03		53	00.02	do	Do.
Mill Hill		46	34.14		00	06.97	do	Do.
Mishaum Point		30	56.11		57	16.44	do	Do.
Monaunt Hill		33	05.51		32	32.48	do	Do.
Monks Hill		57	39.11		43	23.40	do	Do.
Monument church		44	32.45		35	49.73	do	Do.
Muskeget Island		20	14.11		17	58.47	do	Do.
Nantucket:								
Baptist church		16	52.66		06	07.00	do	Do.
Great Point light-house		23	24.34		02	46.06	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			70°-71°				
Nantucket—Continued.	°	′	″	°	′	″		
North towered church	41	17	09.94	70	06	08.22	C. & G. S.	Rept. '85.
Cliff Range beacon (rear)		17	35.55		06	25.10	do	Do.
Cliff		17	35.81		06	58.79	do	Do.
South towered Unitarian church		16	56.72		05	58.09	do	Do.
Range beacon		16	23.92		04	42.86	do	Do.
Nashaquitsa Cliff		20	00.34		44	27.30	do	Do.
Nashawena		25	30.97		52	06.61	do	Do.
Naushon		29	25.03		44	33.38	do	Do.
Southwest		27	01.82		47	19.97	do	Do.
Northeast		30	35.72		42	45.91	do	Do.
Ned Point light-house		39	03.34		47	46.11	do	Do.
New Bedford:								
Court-house		38	03.72		55	52.96	do	Do.
Baptist church		38	12.37		55	36.98	do	Do.
Beacon		36	33.62		53	28.73	do	Do.
Fort		37	27.06		54	10.37	do	Do.
New Falmouth		33	42.42		37	52.42	do	Do.
Nobska Point light-house		30	57.24		39	20.20	do	Do.
No Man's Land		15	11.70		48	49.20	do	Do.
North Dennis		44	42.24		12	29.82	do	Do.
Gray spire		44	14.85		11	32.53	do	Do.
White spire		44	13.77		11	35.41	do	Do.
North Dennis, 2		43	29.20		12	04.70	do	Do.
North Falmouth, spire		38	33.32		37	07.29	do	Do.
North Plymouth Rope Works		58	47.50		41	20.16	do	Do.
North Pond		17	33.41		10	32.15	do	Do.
North Wellfleet:								
Methodist belfry		56	19.66		01	48.95	do	Do.
Congregational belfry		56	09.64		01	16.48	do	Do.
Orleans		47	32.47		00	51.46	do	Do.
Orleans, 2		47	32.59		00	51.63	do	Do.
Osterville		37	52.16		22	57.14	do	Do.
Spire		37	42.08		23	09.29	do	Do.
Osterville Point		37	02.13		22	10.70	do	Do.
Padanaram		35	39.27		56	35.73	do	Do.
Gray spire		35	20.12		56	28.07	do	Do.
Palmer Island light-house		37	37.27		54	34.72	do	Do.
Pamanset River		31	41.30		59	30.99	do	Do.
Pasque		26	57.82		50	04.43	do	Do.
Peaked Cliff		48	31.38		32	25.06	do	Do.
Penikese		26	58.17		55	26.91	do	Do.
Pigeon Hill		50	58.24		59	44.57	do	Do.
Pine Hill		42	31.13		33	58.61	do	Do.
Plymouth		57	24.78		40	07.93	do	Do.
National monument		57	36.69		40	34.87	do	Do.
Pier head		58	46.50		39	13.38	do	Do.
Court-house		57	26.37		40	02.23	do	Do.
Cliff		49	40.62		32	37.24	do	Do.
Pocasset, spire		41	41.55		36	18.28	do	Do.
Point Gammon		37	04.96		15	39.32	do	Do.
Point Gammon, 2		37	04.96		15	39.32	do	Do.
Point Gammon light-house		36	35.00		16	00.19	do	Do.
Prospect Chilmark		21	56.84		44	51.05	do	Do.
Prospect House, cupola flagstaff		26	41.34		34	45.39	do	Do.
Rock Point		46	12.95		04	46.02	do	Do.
Round Hill		32	24.79		55	50.59	do	Do.
Round Hill (Dumpling Rock), light-house.		32	17.88		55	19.09	do	Do.
Sampson (Marthas Vineyard)		22	41.51		29	02.66	do	Do.
Sandwich, Orthodox church		45	28.35		30	00.45	do	Do.
Scargo		44	22.48		10	49.82	do	Do.
Schaum		45	25.10		30	49.98	do	Do.
Sconticut Neck		35	02.65		51	20.39	do	Do.
Scorton Hill		43	17.26		23	41.43	do	Do.
Scorton Neck		44	19.13		24	41.19	do	Do.
Scraggy Neck		39	59.28		39	15.57	do	Do.
Sears		44	38.30		07	57.09	do	Do.
Seaview House, north tower		27	28.54		33	23.06	do	Do.
Shawankemo		17	01.80		03	04.82	do	Do.
Shootflying		41	07.33		20	49.74	do	Do.
Sippican church		42	09.92		45	47.88	do	Do.
Sippican Neck		40	35.93		42	58.05	do	Do.
South Dennis		39	06.59		08	12.40	do	Do.
North spire		40	34.25		09	24.49	do	Do.
South spire		40	21.64		09	23.64	do	Do.
South Pocasset spire		40	36.28		36	22.83	do	Do.
Spring Hill Academy		44	58.86		27	36.58	do	Do.
Succonnesset		33	31.43		28	36.29	do	Do.
Sursuit Creek		45	32.41		08	37.40	do	Do.
Swift Hill		34	02.46		38	30.70	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			70°-71°				
	°	′	″	°	′	″		
Tarpaulin Cove light-house	41	28	07.90	70	45	28.74	C. & G. S.	Rept. '85.
Tempes Knob		42	58.46		39	48.84	do	Do.
Truro, Congregational church spire		59	54.06		03	18.44	do	Do.
Tuckamuck telegraph		18	14.51		15	08.47	do	Do.
Union chapel		27	16.82		33	31.05	do	Do.
Wareham Baptist church		45	27.19		43	03.63	do	Do.
Watcha		20	52.19		36	38.35	do	Do.
Weeweeder Pond		14	35.28		05	37.92	do	Do.
Wenaumet Neck		40	58.14		39	41.00	do	Do.
West Chatham		40	09.42		01	42.19	do	Do.
West Chop		28	54.29		36	18.04	do	Do.
West Chop (Holmes Hole) light-house		28	51.06		36	00.96	do	Do.
West Chop, 2		28	52.61		35	58.26	do	Do.
West Island		34	56.62		49	20.79	do	Do.
West Island, 2		35	25.09		49	04.85	do	Do.
West Yarmouth, spire		38	59.08		13	46.73	do	Do.
Wild Harbor		38	22.19		39	09.05	do	Do.
Windmill Range		16	40.22		06	49.57	do	Do.
Wing Neck light-house		40	49.38		39	41.75	do	Do.
Wolasha Hill		20	29.02		48	38.50	do	Do.
Woods Hole		31	38.80		39	41.58	do	Do.
Episcopal church		31	19.86		39	48.10	do	Do.
Yarmouth Port, spire		42	24.82		14	37.13	do	Do.
	41°-42°			71°-72°				
Alex	41	54	07.08	71	03	34.97	do	Do.
Almy		30	42.29		01	49.85	do	Do.
Attleboro		56	54.14		17	22.60	do	Do.
Assonet		47	25.35		05	56.88	do	Do.
Spire		47	45.95		04	08.00	do	Do.
Flat-topped church, west gable chimney.		47	30.26		04	15.24	do	Do.
Bare top		48	52.85		06	00.44	do	Do.
Beacon		42	16.82		10	29.71	do	Do.
Beveled barn		50	12.73		07	09.14	do	Do.
Birch		52	08.52		05	04.66	do	Do.
Blackbeard		40	28.88		10	58.83	do	Do.
Bluff (Taunton River)		45	54.52		07	49.70	do	Do.
Bradford		54	17.32		04	38.04	do	Do.
Briggs (Taunton River)		54	56.20		03	49.46	do	Do.
Brown Hill (Taunton River)		47	25.29		06	27.65	do	Do.
Bryant Hill		49	39.79		04	43.71	do	Do.
Burns		44	26.70		08	52.72	do	Do.
Burt		51	28 72		05	49.61	do	Do.
Canonicus		53	10.26		02	47.30	do	Do.
Calvary		43	40.82		08	05.04	do	Do.
Carpenter		51	36.08		05	33.64	do	Do.
Chase		40	23.92		11	16.46	do	Do.
City		41	43.77		10	19.09	do	Do.
Clark		51	52.70		05	13.14	do	Do.
Copecut		43	17.24		03	36.64	do	Do.
Cord		53	56.12		02	36.60	do	Do.
Cupola		52	31.55		05	48.05	do	Do.
Dartmouth		34	11.59		01	47.54	do	Do.
Dean		54	37.32		04	15.35	do	Do.
Depot		46	31.09		07	15.07	do	Do.
Dodge's stable, turret		40	56.33		10	40.24	do	Do.
Durfees, cupola		42	36.36		09	04.82	do	Do.
Eddy		54	24.83		03	58.18	do	Do.
Eldridge		31	46.11		05	08.27	do	Do.
Elisha		53	58.58		02	23.21	do	Do.
Elm		53	51.72		02	17.50	do	Do.
Fall River		42	39.25		08	45.54	do	Do.
Derrick		42	19.32		09	56.72	do	Do.
Tower		42	00.87		09	25.42	do	Do.
Spire		42	06.87		09	15.00	do	Do.
Fall River, 2		42	39.74		08	45.38	do	Do.
Ferry wharf, chimney		42	34.30		10	46.90	do	Do.
Frederick		53	41.36		04	27.12	do	Do.
Florence		50	45.08		06	58.03	do	Do.
French		53	35.60		05	34.67	do	Do.
Gardner Neck		42	33.74		12	24.81	do	Do.
George		53	17.58		02	48.11	do	Do.
Globe village, chimney		41	17.27		10	23.84	do	Do.
Gooseberry Neck		29	20.08		02	19.61	do	Do.
Grave		54	04.71		02	38.62	do	Do.
Graveyard		49	34.48		07	28.94	do	Do.
Great Rock		51	32.36		17	15.47	do	Do.
Great Meadow		52	45.14		13	02.29	do	Do.
Hall		54	22.37		04	16.29	do	Do.
Hampden		53	20.15		02	23.86	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
tch (Taunton River)	41	53	01.44	71	05	13.98	C. & G. S.	Rept. '85.
nry		54	23.12		03	12.80	do	Do.
rbert		51	45.41		05	46.99	do	Do.
rring River, spire		40	13.01		07	02.58	do	Do.
gh		50	57.52		06	29.89	do	Do.
ppin Hill		57	52.71		20	52.27	do	Do.
nt		52	38.99		05	30.23	do	Do.
se		53	11.99		02	19.21	do	Do.
hnson		58	20.81		04	43.52	do	Do.
Sandford		35	37.56		07	55.53	do	Do.
mball		53	48.89		02	27.11	do	Do.
ng		54	22.66		03	49.49	do	Do.
g Rock		45	22.82		16	17.27	do	Do.
ck		47	30.99		07	02.32	do	Do.
plewood		53	27.74		02	12.91	do	Do.
rsh (Taunton River)		47	38.18		07	33.80	do	Do.
rtin		54	23.42		03	28.48	do	Do.
son		54	29.24		04	11.14	do	Do.
sachusetts south base		54	49.92		18	16.11	do	Do.
ttapoisett		42	40.47		12	51.76	do	Do.
adow		51	11.22		06	11.96	do	Do.
w		49	33.06		06	58.42	do	Do.
hols		48	25.97		06	59.36	do	Do.
tas		32	13.02		07	25.83	do	Do.
th Dighton		51	14.52		06	39.39	do	Do.
ton, dark-red spire		58	10.49		10	55.37	do	Do.
Hill		54	51.24		16	43.23	do	Do.
elford		54	08.02		03	12.26	do	Do.
e (Taunton River)		54	12.54		02	58.18	do	Do.
ksand		30	01.73		07	12.18	do	Do.
cksand, 2		29	56.40		07	09.16	do	Do.
hmond Hill		48	27.29		07	43.35	do	Do.
ge		45	33.46		07	10.98	do	Do.
er		51	36.08		06	17.02	do	Do.
ch		54	08.44		02	27.97	do	Do.
kheap		53	44.16		02	12.70	do	Do.
acus		53	19.88		02	35.87	do	Do.
olhouse Hill		50	01.41		06	17.56	do	Do.
e		43	41.20		10	09.12	do	Do.
erset		44	07.60		10	06.49	do	Do.
Meetinghouse		44	11.54		10	06.89	do	Do.
Spire		46	17.88		07	38.87	do	Do.
erset, 2		43	44.05		10	08.16	do	Do.
wbetty		53	20.27		02	05.70	do	Do.
White spire		52	57.87		01	39.97	do	Do.
Nail factory		53	12.16		01	54.03	do	Do.
p Brook		44	56.97		07	23.16	do	Do.
p Brook, church		44	30.40		07	46.13	do	Do.
ewall		53	34.08		02	04.19	do	Do.
nzey belfry		45	03.22		13	30.90	do	Do.
more		53	37.91		02	20.91	do	Do.
ton:								
nitarian Church		54	04.57		05	19.92	do	Do.
ron works, chimney		52	54.11		05	38.55	do	Do.
graph		50	59.36		06	50.33	do	Do.
y		46	31.46		06	43.07	do	Do.
sher		52	22.47		05	16.73	do	Do.
ication:								
outh base		50	13.04		21	28.68	do	Do.
orth base		54	25.94		21	20.68	do	Do.
er		54	23.22		02	57.83	do	Do.
nburn		53	25.41		01	56.49	do	Do.
r tower		59	46.52		19	21.66	do	Do.
erworks		54	11.20		03	50.62	do	Do.
amoe		53	08.94		02	30.19	do	Do.
ur		54	40.30		05	11.67	do	Do.
ams		52	43.06		05	52.70	do	Do.
more		52	12.51		05	31.91	do	Do.
l		45	03.10		08	27.35	do	Do.
ls		54	19.08		02	44.92	do	Do.

RHODE ISLAND.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Achilles	41	19	15.35	71	48	47.54	C. & G. S	Rept. '85.
Ajax		20	35.86		41	17.40	do	Do.
Aldrich		50	23.92		40	11.00	do	Bull. 122.
Anderson, barn cupola		33	41.31		17	23.46	do	Rept. '85.
Anthony		38	46.85		13	18.64	do	Do.
Mill		41	47.30		32	47.82	do	Bull. 122.
Apponaug, spire		41	55.84		27	30.08	do	Rept. '85.
Arnold		45	14.48		23	41.75	do	Do.
Austin		24	25.28		28	44.90	do	Do.
Babcock		42	44.36		18	24.80	do	Do.
Balch, house, north chimney		29	00.51		16	20.91	do	Do.
Barber Height		31	44.87		25	28.10	do	Do.
Barker		38	23.01		12	06.65	do	Do.
Barn cupola		32	08.72		22	36.98	do	Do.
Barn, white cupola		42	22.66		16	55.43	do	Do.
Barn, west gable		28	35.10		23	28.36	do	Do.
Batty		32	13.24		22	36.23	do	Do.
Farm		45	34.90		24	35.80	do	Do.
Beaconpole		59	42.47		27	01.26	do	Do.
Beaconpole (Borden)		00	03.26		26	43.16	do	Do.
Beavertail, light-house		26	56.86		23	59.42	do	Do.
Do		26	57.89		23	59.57	do	Do.
Bentley		21	51.91		45	33.28	do	Do.
Big Hill		23	26.36		46	08.49	do	Do.
Block Island		10	32.08		35	30.64	do	Do.
Derrick		09	10.01		33	06.80	do	Do.
North light-house (1874)		13	39.66		34	34.74	do	Do.
North light-house (1838)		13	29.15		34	33.05	do	Do.
Southeast light-house (1875)		09	10.12		33	08.39	do	Do.
Border Hill, topographical pole		23	26.74		38	29.70	do	Do.
Boston Neck		28	19.08		26	05.43	do	Do.
Bristol:								
Court-house		40	12.66		16	25.67	do	Do.
Methodist church		40	15.39		16	31.88	do	Do.
Broad Hill		24	39.95		38	42.82	do	Do.
Brown (E.), house chimney		19	54.22		45	25.62	do	Do.
Brown (E.), house cupola		45	04.44		23	24.20	do	Do.
Browning, house chimney		32	00.82		25	49.54	do	Do.
Browning (W.T.), house, center chimney.		23	12.44		34	36.28	do	Do.
Bullock Neck (Borden)		44	42.27		21	35.11	do	Do.
Bullock Neck		44	42.90		21	27.69	do	Do.
Bullock Neck, 2		44	43.00		21	35.16	do	Do.
Bunker Hill		23	10.16		39	16.35	do	Do.
Bushy Hill		12	43.99		33	40.56	do	Do.
Buttonwood House, cupola		41	19.12		25	58.28	do	Do.
Butts		36	55.84		15	06.56	do	Do.
Butts, 2		36	55.74		15	07.48	do	Do.
Calf Pasture Point		37	40.62		24	18.90	do	Do.
Castle Hill		27	53.02		21	28.80	do	Do.
Castle Island Beacon (1843)		39	13.97		17	12.20	do	Do.
Champlin		29	16.00		46	47.77	do	Do.
Do		29	16.04		46	47.91	G. S	Bull. 122.
Church Point		30	00.12		12	23.96	C. & G. S	Rept. '85.
Church Point, 2		30	09.92		12	21.01	do	Do.
Coal Mines, middle chimney		37	09.94		16	26.83	do	Do.
College Hill		50	18.85		24	00.63	do	Do.
Commons		21	15.21		43	54.70	do	Do.
Conanicut, north		34	24.86		22	19.87	do	Do.
Conimicut		43	01.67		21	29.44	do	Do.
Cormorant Hill		23	37.22		49	03.45	do	Do.
Cornell		37	18.96		09	16.52	do	Do.
Cranberry Hill		20	53.23		47	22.77	do	Do.
Cranberry Hill, 2		20	53.40		47	22.80	do	Do.
Davis (O.), house, east gable chimney		20	56.91		44	09.26	do	Do.
Dawley		32	12.06		30	02.68	do	Bull. 122.
Diamond Hill, tree		25	46.62		46	28.73	do	Rept. '85.
Dumplin		28	45.68		22	07.86	do	Do.
Dumplin, 2		28	45.69		22	07.86	do	Do.
Dunn House, white chimney		21	06.38		46	07.44	do	Do.
Dutch Island:								
Flagstaff (1868)		30	19.30		24	04.75	do	Do.
Light-house (1868)		29	48.28		24	17.18	do	Do.
Dyer Island		34	57.25		17	55.49	do	Do.
East Rock		27	04.65		11	38.34	do	Do.
Fairground, tower		31	16.61		16	27.84	do	Do.
Fishhouse, chimney		34	41.97		26	51.84	do	Do.
Fogland Point House		33	42.90		13	11.65	do	Do.
Fort Adams:								
Flagstaff (1869)		28	45.88		20	20.25	do	Do.
Flagstaff (1843)		28	47.51		20	14.24	do	Do.

RHODE ISLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
ort Hill	41	20	01.27	71	49	15.13	C. & G. S	Rept. '85.
ort Independence		47	34.44		23	33.38	do	Do.
ort Independence, 2		47	34.41		23	33.49	do	Do.
our Corners, belfry		34	31.52		11	22.41	do	Do.
ox Island		33	16.24		25	04.48	do	Do.
House chimney		33	15.00		25	06.59	do	Do.
ox Point, rolling-mill chimney		48	59.70		23	55.82	do	Do.
ranklin		35	41.35		33	56.30	do	Bull. 122.
ibbs		29	36.69		16	29.18	do	Rept. '85.
ibbs, 2		29	39.54		16	28.38	do	Do.
at Island, light-house (1843)		29	36.09		19	39.10	do	Do.
ould Island		32	04.30		20	42.02	do	Do.
Barn cupola		32	02.08		20	41.06	do	Do.
overnors Island		21	19.42		30	12.29	do	Do.
reen, barn cupola		33	42.34		26	31.25	do	Do.
reen Hill		22	24.70		35	51.59	do	Do.
een Point		41	03.60		24	43.18	do	Do.
swold, barn, south cupola		32	58.69		14	20.83	do	Do.
lfway Rock		33	49.82		19	58.34	do	Do.
ll		43	12.06		17	05.59	do	Do.
ll (Ben), house, west chimney		35	08.27		16	41.43	do	Do.
milton Mills, cupola		32	57.49		26	17.05	do	Do.
rris, barn, east cupola		22	19.74		40	22.64	do	Do.
ard (A. P.)		28	23.25		19	17.59	do	Do.
House, center chimney		24	34.68		33	04.20	do	Do.
Castle		24	55.10		27	28.37	do	Do.
ctor		19	31.66		47	20.57	do	Do.
gh Hill		32	51.03		12	59.46	do	Do.
gh Rocks		37	47.56		26	08.78	do	Do.
cox		21	29.18		42	14.56	do	Do.
g Island		38	40.38		16	50.58	do	Do.
g Island, 2		38	40.48		16	50.79	do	Do.
g Island, 3		38	40.48		16	50.82	do	Do.
pe Island		36	10.30		21	59.62	do	Do.
Barn		36	09.97		22	00.42	do	Do.
wland, barn cupola		32	04.17		11	46.08	do	Do.
l		32	14.56		22	36.23	do	Do.
es		32	41.81		39	52.97	do	Do.
hua Champlin		22	16.39		39	55.33	do	Do.
yon		23	25.33		37	01.43	do	Do.
yon (H. G.), house, center chimney.		22	56.41		37	06.67	do	Do.
le Point		47	46.34		22	41.04	do	Do.
gston, church spire		28	48.90		31	33.54	do	Do.
ncut		47	47.84		21	57.48	do	Do.
pp Point, house chimney		18	22.53		53	07.63	do	Do.
ton, house, flagstaff		37	33.40		12	48.97	do	Do.
rty Pole		21	41.54		37	21.90	do	Do.
le Compton		31	12.38		11	00.71	do	Do.
le Compton, 2 (1870)		31	12.44		11	01.69	do	Do.
Church spire		30	33.63		10	18.35	do	Do.
parrow		29	46.95		27	24.74	do	Do.
parrow, 2		29	47.79		27	24.35	do	Do.
nghouse Hill		26	45.32		28	33.93	do	Do.
nghouse Hill, 2		26	43.17		28	33.55	do	Do.
tonomy		30	37.05		18	37.43	do	Do.
nd		38	14.04		13	11.91	do	Do.
nt Hope (Borden)		40	27.55		14	26.15	do	Do.
nt Hope		40	26.13		14	26.21	do	Do.
nt Hope, 2		40	26.52		14	26.09	do	Do.
ford, Cranston		46	13.10		33	15.83	do	Bull. 122.
roe (Borden)		46	34.35		19	05.61	do	Rept. '85.
agansett, church		29	33.60		25	33.46	do	Do.
agansett Bay, yellow barn cupola		41	01.77		27	13.58	do	Do.
tt light-house (1863)		43	30.64		20	21.88	do	Do.
tt light-house (1843)		43	30.09		20	22.31	do	Do.
aconkanut		48	41.08		28	03.06	do	Do.
port:								
onson's house flagstaff		27	51.76		21	28.23	do	Do.
hurch		29	14.46		18	49.71	do	Do.
lmont's house cupola		27	52.17		18	22.46	do	Do.
atholic church spire		28	49.06		18	49.38	do	Do.
ean House		28	53.24		18	30.59	do	Do.
Weeden		22	54.29		33	16.31	do	Do.
Popasquash		40	54.61		18	12.28	do	Do.
Windmill		35	16.01		15	16.18	do	Do.
heast corner of Connecticut		01	24.82		48	04.20	do	Do.
west corner of Rhode Island		00	29.15		47	58.92	do	Do.
s Neck		19	46.49		45	19.84	do	Do.
s Point		19	46.31		45	19.44	do	Do.

RHODE ISLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Nye's (R.) house, white chimney	41	21	54.53	71	46	28.12	C. & G. S	Rept. '85.
Paine		09	18.85		33	44.99	do	Do.
Pappoose Squaw		39	15.20		18	02.52	do	Do.
Pappoose Squaw, 2		39	15.20		18	02.45	do	Do.
Paradise Rock		30	05.51		15	45.50	do	Do.
Patience		39	33.47		21	24.58	do	Do.
Pawhungernock, church		30	20.06		50	25.46	do	Do.
Pawtucket:								
Spire		52	36.04		22	53.84	do	Do.
Dark spire		52	53.95		23	05.06	do	Do.
Pawtuxet		45	56.80		23	13.95	do	Do.
Borden		45	14.19		23	41.72	do	Do.
Beacon (1843)		45	35.56		22	50.95	do	Do.
Church spire		45	59.12		23	30.53	do	Do.
Peleg Tiff		23	18.75		48	40.42	do	Do.
Peirce:								
Barn		48	22.47		22	59.79	do	Do.
Barn cupola		25	34.08		28	50.74	do	Do.
Pine Hill		38	00.47		20	35.81	do	Do.
Pocasset		39	09.42		11	32.36	do	Do.
Point Judith		21	54.84		29	17.94	do	Do.
Light-house (1838)		21	30.88		28	54.73	do	Do.
Pojack		39	04.92		24	27.97	do	Do.
Pomham		46	42.15		21	28.04	do	Do.
Beacon (1843)		46	35.13		22	27.08	do	Do.
Poorhouse:								
Belfry		30	26.86		19	43.31	do	Do.
Northeast gable		35	21.98		24	50.76	do	Do.
Portsmouth, belfry		36	13.34		14	53.67	do	Do.
Portsmouth Grove, flagstaff		35	13.03		17	13.73	do	Do.
Potter's windmill shaft		30	56.30		22	28.66	do	Do.
Potter's (widow) barn		33	18.00		12	17.07	do	Do.
Potter's (A.) house chimney		30	29.90		21	38.60	do	Do.
Potter's (Dr.) house chimney		27	00.95		26	30.46	do	Do.
Prince		44	34.61		18	56.32	do	Do.
Prospect Hill		49	44.64		24	20.85	do	Do.
Providence:								
Baptist church		49	38.92		24	32.12	do	Do.
Congregational church		49	12.90		24	50.78	do	Do.
High Street church		49	05.73		25	16.25	do	Do.
Unitarian church		49	27.89		24	19.99	do	Do.
Quaker College		50	00.56		23	56.34	do	Do.
Vitriol works chimney		49	49.56		25	21.92	do	Do.
Prudence		36	24.42		18	42.59	do	Do.
2 (1869)		36	22.23		18	41.81	do	Do.
Island, light-house (1861)		36	21.34		18	14.46	do	Do.
Island, light-house (1869)		36	28.93		18	30.35	do	Do.
South		34	44.45		19	32.96	do	Do.
Quaker		34	57.38		15	18.34	do	Do.
Quonochontaug		19	59.99		42	37.33	do	Do.
Quonsett		35	26.58		24	33.70	do	Do.
Quonsett, 2		35	16.90		24	23.02	do	Do.
Quonsett, 3 (1868)		35	17.03		24	23.20	do	Bull. 122.
Reynolds		33	45.55		26	52.10	do	Rept. '85.
Rocky Point		41	29.72		21	50.06	do	Do.
Hotel chimney		41	21.91		21	56.52	do	Do.
Rose Island		29	48.20		20	34.44	do	Do.
Flagstaff		29	47.52		20	34.30	do	Do.
Rumstick		42	24.05		18	07.76	do	Do.
Sable Point		46	02.38		22	06.14	do	Do.
Sakonnet Point		27	16.36		11	46.09	do	Do.
Sanders's (E.) house chimney		20	26.32		44	46.60	do	Do.
Sandford, mill cupola		33	05.93		26	53.50	do	Do.
Sandhill		21	40.62		42	17.39	do	Do.
Sandy Point		39	43.29		24	37.14	do	Do.
Schoolhouse chimney		32	18.25		22	33.32	do	Do.
Seventh-Day meetinghouse, north chimney.		23	36.04		36	30.00	do	Do.
Shannock		28	05.19		38	21.49	do	Do.
Shaw's (Peter) barn cupola		29	14.50		08	45.72	do	Do.
Sherman		30	16.94		30	56.19	G. S	Bull. 122.
Sherman		30	16.94		30	56.02	C. & G. S	Rept. '85.
Sherman's (J. P.) house center chimney.		23	25.18		31	45.62	do	Do.
Sherman, house chimney		33	47.42		22	24.25	do	Do.
Signal flag		35	32.16		25	42.20	do	Do.
Simmons		29	32.29		09	34.21	do	Do.
Simmons, 2		29	32.08		09	34.66	do	Do.
Slate		32	21.01		15	59.64	do	Do.
Slate Hill, flagstaff (1869)		32	22.15		15	56.41	do	Do.
Smith, barn cupola		36	00.02		25	23.04	do	Do

RHODE ISLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Portsmouth:								
iscopal church tower	41	32	50.30	71	15	42.34	C. & G. S	Rept. '85.
nion church tower		33	30.18		15	21.90	do	Do.
Rock		34	26.66		25	03.67	do	Do.
Island		41	17.40		13	14.68	do	Do.
er		40	43.26		29	40.68	do	Do.
er (2), Warwick		40	38.87		29	49.30	do	Bull. 122.
nt Island, house, north gable		47	10.00		22	55.92	do	Rept. '85.
ıs		44	44.13		22	56.05	do	Do.
af Hill		26	04.96		30	40.02	do	Do.
rn cupola		31	32.92		25	34.92	do	Do.
use chimney		28	01.34		27	37.94	do	Do.
aph		27	47.83		20	11.63	do	Do.
aph. 2		27	47.28		20	11.61	do	Do.
		27	48.56		32	15.70	do	Bull. 122.
on. cupola		37	30.25		12	50.91	do	Rept. '85.
raphical pole, near post road		23	41.82		35	54.60	do	Do.
raphical pole, 3		23	17.94		35	17.72	do	Do.
raphical pole, 4		23	59.28		32	40.78	do	Do.
raphical pole, 6		24	00.68		33	31.32	do	Do.
llot. Gloucester		53	40.34		39	16.48	do	Bull. 122.
Hill, church		28	02.85		27	35.23	do	Rept. '85.
t		41	59.23		14	33.74	do	Do,
t Neck (Borden)		42	45.02		13	36.28	do	Do.
ı. house cupola		34	25.62		27	45.68	do	Do.
Hill		20	54.17		44	59.29	do	Do.
l'Eau Hotel		47	15.82		22	05.09	do	Do.
eld:								
staff		26	05.03		30	40.05	do	Do.
rch, gray spire		26	25.58		29	50.95	do	Do.
rch, white spire		26	24.25		30	11.06	do	Do.
:								
e		43	48.47		17	04.14	do	Do.
hodist spire		43	48.78		17	02.72	do	Do.
on (1863)		42	48.74		17	37.24	do	Do.
k beacon (1843)		39	25.02		23	36.17	do	Do.
k light-house (1863)		40	01.43		22	43.28	do	Do.
k Neck		41	21.10		22	49.72	do	Do.
Hill		18	49.93		51	17.20	do	Do.
t-house		18	14.19		51	32.43	do	Do.
house chimney		28	22.37		26	05.70	do	Do.
Coventry		39	37.21		39	49.84	do	Bull. 122.
		22	50.89		33	15.24	do	Rept. '85.
l		25	56.65		45	15.92	do	Do.
		38	44.42		15	42.00	do	Do.
land, New York Club flag-[illegible]).		27	00.81		11	59.08	do	Do.
		21	59.88		40	52.84	do	Do.
s (D.) house, east chimney		24	56.65		27	16.49	do	Do.
ouse:								
chimney		23	20.46		29	18.66	do	Do.
ı chimney		40	46.09		27	04.36	do	Do.
		40	33.89		27	19.36	do	Do.
		34	30.54		28	02.69	do	Do.
my		34	06.68		27	21.19	do	Do.
st church		34	19.58		27	05.35	do	Do.
house (1868)		34	15.92		26	22.59	do	Do.
		34	23.40		27	00.02	do	Do.
		29	29.63		38	32.54	do	Do.
nill		29	24.36		11	02.56	do	Do.
		21	23.20		43	59.86	do	Do.
		32	33.62		11	50.48	do	Do.
2 (1869)		32	33.56		11	50.51	do	Do.
		35	23.22		11	10.35	do	Do.
et		58	40.81		33	15.16	do	Bull. 122.
rn. cupola		22	31.40		37	26.60	do	Rept. '85.
use. chimney		43	41.87		19	23.20	do	Do.

CONNECTICUT.

	42°-43°			73°-74°				
	°	′	″	°	′	″		
Mount Riga	42	00	43.33	73	27	57.84	C. & G. S	Rept. '88.
nt line (Borden)		02	58.78		29	42.92	do	Do.
	41°-42°			71°-72°				
machine works cupola	41	19	49.32	71	54	26.23	do	Do.
		47	59.79		27	21.40	do	Bull. 122.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Referenc
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Chapman Hill	41	29	32.28	71	51	40.57	C. & G. S	Bull. 12
Eels Hill, 2		22	49.87		51	04.35	do	Rept. '85
Frost		20	57.57		51	03.25	do	Rept. '86
Grant Hill		25	25.17		54	06.05	do	Do.
Jesse Main		26	31.63		49	15.00	do	Do.
Lantern Hill		27	37.93		56	40.83	do	Do.
Morgan Point, light-house (1874–1886)		18	59.43		59	23.67	do	Do.
Mount Riga (on Ball Peak)		00	43.33		27	57.84	do	Rept. '85
Noank, spire (1882)		19	33.76		59	13.14	do	Do.
North Stonington		25	59.53		51	20.72	do	Do.
Northeast corner of Connecticut (Borden).		01	24.82		48	04.20	do	Do.
Palmer		21	37.29		55	41.92	do	Rept. '8
Portersville, spire (1835)		21	14.80		58	24.87	do	Do.
Powkhungemock church (1838)		30	20.06		50	25.46	do	Do.
Quacatog		23	15.29		56	58.57	do	Do.
Ram Island:								
Hotel flagstaff		18	40.34		58	46.45	do	Do.
Reef Spindle (1835)		18	23.16		58	29.42	do	Do.
Road Meetinghouse (1838)		22	23.44		54	51.18	do	Do.
Sandford		27	42.80		56	59.30	do	Rept. '85
Stonington:								
Meetinghouse (1835)		20	12.24		54	21.08	do	Rept. '8
Harbor, light-house (1873–1886)		19	42.72		54	21.59	do	Do.
Walnut Hill		25	14.80		54	35.66	do	Do.
Wamposset		19	44.65		55	16.93	do	Do.
Wilcox, fish works, brick chimney		19	59.45		57	13.04	do	Do.
	41°-42°			72°-73°				
Allen	41	17	40.30	72	58	23.88	do	Do.
Arnold Quarry		28	26.06		30	28.54	do	Do.
Avery Hill		28	02.90		02	58.71	do	Do.
Avery Hill, 2		20	21.52		04	05.25	do	Do.
Avery Point		18	57.59		03	52.58	do	Do.
Avery Point, 2 (1882)		18	57.02		03	52.68	do	Do.
Ayer		19	55.92		21	38.38	do	Do.
Bailey		22	51.64		04	56.93	do	Do.
Bald Hill		58	25.89		11	55.03	do	Bull 12
Do		27	43.10		25	06.86	do	Rept. '8
Baldwin		24	06.00		04	40.25	do	Do.
Barker		15	15.84		48	34.22	do	Do.
Bartlett		14	54.10		42	44.85	do	Do.
Beacon		18	48.03		03	58.98	do	Do.
Hill		17	34.65		24	08.85	do	Do.
Hill, 3 (1882)		17	34.38		24	09.32	do	Do.
Beckwith		21	12.50		21	23.04	do	Do.
Bethany:								
Church spire		25	30.92		59	47.33	do	Do.
South		23	34.15		58	03.90	do	Do.
Bigelow's house, chimney		18	09.63		54	04.21	do	Do.
Bill Hill		20	11.20		59	08.35	do	Do.
Block Point		17	09.68		12	19.75	do	Do.
Block Point, 2 (1882)		17	11.78		12	17.37	do	Do.
Bluff Point		18	53.97		02	04.97	do	Do.
Bog Hole Hill		18	49.74		18	56.90	do	Do.
Bog Hole Hill, 2 (1861)		18	49.74		18	53.95	do	Do.
Bolles Hill		27	49.24		04	43.04	do	Do.
Book Hill		22	06.53		24	47.38	do	Do.
Boulder		14	34.79		42	21.46	do	Do.
Bradley		17	14.20		49	28.04	do	Do.
Brainerd		29	18.49		31	35.95	do	Do.
Branford, Congregational church spire (1876).		16	52.22		48	40.61	do	Do.
Branford Reef, beacon (1881-1882)		13	16.78		48	20.68	do	Do.
Brethren		24	53.18		55	48.69	do	Do.
Brewster's Factory cupola		18	09.46		54	38.72	do	Do.
Bridge		17	33.28		55	59.19	do	Do.
Broadway church		31	34.05		04	33.65	do	Do.
Brockway		23	23.04		23	18.73	do	Do.
Brooks		25	24.26		25	42.99	do	Do.
Browning		25	05.54		06	23.63	do	D
Buckingham		22	56.35		23	47.90	do	D
C		16	14.33		54	21.20	do	D
Camp Hill		16	30.41		34	13.41	do	D
Canal Dock		17	38.30		54	52.73	do	D
Case		22	31.63		53	32.34	do	Do.
Cedar		31	08.33		05	25.87	do	Do.
Do		22	41.98		23	40.05	do	Do.
Do		17	43.14		57	44.57	do	Do.
Centerville, church		23	01.59		54	11.50	do	D
Champion House flagstaff		27	42.76		27	53.32	do	D
Chapin		18	01.01		06	45.28	do	D

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
on. cupola	41	31	41.22	72	04	50.63	C. & G. S	Rept. '88.
works ventilator		16	07.90		54	07.34	do	Do.
church spire		29	52.78		54	12.18	do	Do.
ling		24	50.52		25	45.96	do	Do.
		24	04.64		27	15.16	do	Do.
t. 1 (1875)		21	56.86		57	05.62	do	Do.
t. 2 (1875)		23	12.86		55	28.34	do	Do.
Hill		31	27.38		25	53.56	do	Do.
int		14	00.32		58	43.15	do	Do.
hurch spire (1882)		16	30.89		31	38.74	do	Do.
Point		15	42.21		23	14.28	do	Do.
Point, 2 (1882)		15	42.48		23	14.73	do	Do.
		24	38.76		26	52.80	do	Do.
		17	55.09		50	58.08	do	Do.
one		24	03.62		05	27.44	do	Do.
		17	44.40		32	29.65	do	Do.
t		24	32.33		05	33.94	do	Do.
r		17	03.14		54	13.95	do	Do.
Congregational church		35	48.75		38	46.76	do	Do.
er spire		23	12.14		26	04.78	do	Do.
n		25	06.94		55	42.34	do	Do.
		17	01.99		56	16.54	do	Do.
		22	27.19		24	47.58	do	Do.
		22	25.18		58	48.29	do	Do.
rick church, spire		18	35.18		53	26.31	do	Do.
nd		15	23.67		28	33.14	do	Do.
nd. 2 (1882)		15	23.91		28	33.26	do	Do.
n:								
		18	35.20		53	26.33	do	Do.
Congregational church		18	27.90		53	08.81	do	Do.
land, light-house (1833-1882)		12	43.18		39	14.45	do	Do.
ty pole		32	08.89		05	28.42	do	Do.
		31	06.86		04	09.50	do	Do.
Iall, flagstaff		16	20.43		21	15.08	do	Do.
		18	57.92		21	56.98	do	Do.
61)		18	57.91		21	57.00	do	Do.
		15	49.62		27	53.71	do	Do.
		31	01.07		04	53.78	do	Do.
		16	58.77		53	58.50	do	Do.
am:								
gational church		28	49.29		26	48.97	do	Do.
al church		27	37.70		27	33.73	do	Do.
ord, square steeple, green		46	08.56		38	41.38	do	Do.
t:								
ff (1875)		16	32.08		52	04.15	do	Do.
		16	41.82		52	19.72	do	Do.
		19	37.42		54	17.44	do	Do.
2 (1871)		19	42.43		54	26.32	do	Do.
House, flagstaff		19	31.46		04	31.67	do	Do.
		21	51.48		22	27.20	do	Do.
		21	51.48		22	27.19	do	Do.
		21	52.97		22	24.74	do	Do.
		32	06.35		32	07.63	do	Do.
		20	33.36		23	49.09	do	Do.
hurch		21	18.26		23	33.57	do	Do.
ational church		21	09.96		23	34.24	do	Do.
l church (1861)		21	11.08		23	32.43	do	Do.
1)		20	33.33		23	49.09	do	Do.
		17	47.40		54	07.40	do	Do.
(1874)		16	14.79		54	18.57	do	Do.
1882)		20	47.82		00	40.65	do	Do.
ull, flagstaff (1882)		20	38.28		05	39.16	do	Do.
r, 3 (1882)		16	55.92		53	35.12	do	Do.
iver, 2 (1882)		18	12.40		16	13.48	do	Do.
rewery cupola		17	56.34		56	36.16	do	Do.
		26	57.58		26	31.49	do	Do.
		25	35.82		53	59.06	do	Do.
		17	57.65		06	47.94	do	Do.
		55	57.08		53	18.88	G. S	Bull. 122.
church		23	45.56		17	16.50	C. & G. S	Rept. '88.
		19	20.44		21	05.84	do	Do.
		17	52.84		36	51.65	do	Do.
ock		15	35.22		30	43.34	do	Do.
		20	31.54		51	11.30	do	Do.
		49	00.26		23	14.32	G. S	Bull. 122.
		17	30.24		39	36.28	C. & G. S	Rept. '88.
		22	38.27		04	54.20	do	Do.
Point		18	26.80		00	21.29	do	Do.
Point, 2 (1882)		18	25.09		00	19.93	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Referen
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Groton Monument	41	21	18.02	72	04	47.45	C. & G. S.	Rept.
Grove		19	02.97		52	57.23	do	Do.
Guard House Point, chimney		15	51.14		22	04.12	do	Do.
Haddam:								
Academy		28	44.81		30	59.76	do	Do.
Congregational church		28	45.82		30	56.05	do	Do.
Court-house		28	50.68		31	00.62	do	Do.
Haddam Neck		28	55.33		29	28.36	do	Do
Congregational church		31	47.50		32	13.46	do	Do.
Methodist church		30	54.47		30	53.26	do	Do.
Flag		29	37.60		30	30.18	do	Do.
Hadlyme, church cupola		25	53.58		24	21.36	do	Do.
Hamburg Cove		22	36.66		22	21.00	do	Do.
Hamden Methodist church		21	11.38		55	53.14	do	Do.
Hammonasset, hotel chimney		16	17.35		35	10.39	do	Do.
Hammonasset, 2 (1882)		14	55.84		32	40.59	do	Do.
Harrison		18	00.48		49	45.16	do	Do.
Hartford:								
South Congregational church		45	34.82		40	33.35	do	Do.
Arsenal flagstaff		46	51.85		40	34.00	do	Do.
Colt's factory		45	24.28		39	48.90	do	Do.
Old State House cupola		45	58.03		40	23.38	do	Do.
Windsor avenue church		46	56.74		40	33.74	do	Do.
Hatchett Point		16	58.81		15	43.53	do	Do.
Hatchett Point, 2 (1882)		17	03.53		15	45.75	do	Do.
Hayden Point		20	37.22		22	38.52	do	Do.
Hemlock		22	27.28		59	03.64	do	Do.
Hemmingway		18	58.19		52	12.37	do	Do.
Hen and Chickens beacon (1882)		15	12.16		24	18.33	do	Do.
Higganum:								
Congregational church		29	51.13		33	20.29	do	Do.
Methodist church		29	54.66		33	49.49	do	Do.
High Hill		20	37.57		37	41.95	do	Do.
Highlands		15	56.18		38	57.53	do	Do.
High Rock		24	18.25		56	07.91	do	Do.
Hillhouse		19	40.61		59	48.57	do	Do.
Hillside		22	52.58		57	57.35	do	Do
Hoadley Neck		15	27.53		44	10.04	do	Do.
Hogshead Point		16	10.60		38	15.26	do	Do.
Holt		25	41.32		27	29.89	do	Do.
Honey Hill		23	49.83		21	34.38	do	Do.
Horse Pond		17	36.20		35	20.92	do	Do.
Horse, cupola of house		14	39.86		45	31.03	do	Do.
Hotchkiss		23	43.87		58	53.50	do	Do.
Howard, 1 (1876)		24	31.72		52	18.81	do	Do.
Howard, 2 (1877)		24	51.14		52	33.05	do	Do.
Huddenston		26	57.06		58	24.78	do	Do.
Hungry Hill		18	49.90		41	33.02	do	Do.
Ives cupola		18	31.69		52	52.00	do	Do.
Indian Neck		15	23.82		49	19.76	do	Do.
Insane asylum, northwest chimney		33	08.02		37	50.08	do	Do.
Jail Hill		31	41.16		04	49.15	do	Do.
Jeremy:								
North		16	13.51		56	03.18	do	Do.
South		15	39.47		56	02.96	do	Do
Jewett		18	46.91		58	22.14	do	Do.
Joe Post light (1861)		23	20.35		25	05.28	do	Do.
Johnny Cake		45	12.79		59	41.01	G. S	Bull.
Jones		27	59.34		27	32.46	C. & G. S	Rept.
Do		15	37.80		58	25.79	do	Do.
Jordan, church tower		18	31.00		07	42.35	do	Do.
Joshua Rock		22	51.84		22	37.80	do	Do.
Kelsey Clinton		15	24.44		30	27.65	do	Do.
Kelsey Westbrook		16	27.00		25	28.46	do	Do.
Kongscut		41	44.35		30	10.15	do	Do.
Lancrofts, cupola		18	05.15		53	17.68	do	Do.
Lay Hill		16	58.26		18	02.04	do	Do
Lay Hill, 2 (1861)		16	58.20		18	02.06	do	Do.
Lay Hill, 3 (1882)		16	57.93		18	01.84	do	Do.
Lebanon		26	26.56		59	38.96	do	Do.
Ledge		25	07.39		05	17.74	do	Do.
Lewis		19	14.73		12	03.15	do	Do.
Lewis Grove		16	16.03		29	08.62	do	Do.
Locust		25	02.22		27	17.72	do	Do
Long Hill		26	45.49		30	24.97	do	Do.
Do		17	26.35		30	47.08	do	Do.
Do		24	08.31		53	09.57	do	Do.
Lord		21	30.88		20	47.42	do	Do.
Lower Pole Hill		27	11.69		07	31.19	do	Do.
Lyme, white Congregational church (1835-1883).		18	46.45		19	56.04	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
on.								
urch spire (1838)	41	16	44.80	72	36	08.85	C. & G. S	Rept. '88.
gregational church spire (1882)		16	47.90		36	12.79	do	Do.
h		20	35.17		20	09.23	do	Do.
ıck		21	15.56		09	08.16	do	Do.
ıck, 2 (1882)		21	15.26		09	03.53	do	Do.
eld		21	52.39		50	20.97	do	Do.
		30	30.13		04	41.83	do	Do.
rd		26	10.51		04	14.49	do	Do.
g House Hill		36	08.68		08	38.97	G. S	Bull. 122.
ketesuck		15	42.73		27	48.99	C. & G. S	Rept. '88
:		24	23.65		56	30.69	do	Do.
town:								
holic church		33	59.08		39	11.92	do	Do.
ian Hill Cemetery, summer- ouse.		33	17.08		39	48.19	do	Do.
th Congregational church		33	36.59		39	05.42	do	Do.
th Congregational church		33	23.25		38	51.74	do	Do.
leyan College chapel		33	20.72		39	23.04	do	Do.
ck		16	48.22		51	47.65	do	Do.
ıe Point		18	18.92		09	54.44	do	Do.
se, west chimney		18	30.40		10	08.21	do	Do.
n:								
rch spire (1838)		28	23.88		05	55.31	do	Do.
rch spire (1874)		28	23.90		05	55.40	do	Do.
ese church		20	55.49		51	45.80	do	Do.
Point		14	32.70		53	39.53	do	Do.
Hill, New Haven		18	22.56		44	34.18	do	Do.
		31	13.47		27	32.64	do	Do.
		30	32.65		05	13.43	do	Do.
armel		25	51.80		53	25.64	do	Do.
phraim		27	47.45		54	56.64	do	Do.
arnassus		28	03.61		24	40.54	do	Do.
rospect		28	22.70		58	16.34	do	Do.
y Point		15	37.52		40	55.47	do	Do.
		17	10.50		28	20.94	do	Do.
k, 2 (1882)		17	06.83		28	21.73	do	Do.
rland Cement Works, smoke-		22	36.18		58	39.97	do	Do.
ven:								
Congregational church		18	34.78		53	38.15	do	Do.
ist church		18	33.50		53	23.82	do	Do.
t-house (1833–1882)		14	56.40		54	15.13	do	Do.
Hall		18	26.57		55	29.87	do	Do.
house cupola		18	55.57		57	08.48	do	Do.
tific School, observatory ver.		18	42.77		55	32.63	do	Do.
Paul's Episcopal church, thwest spire.		18	13.74		55	13.86	do	Do.
atrick's church		18	30.72		54	42.41	do	Do.
e church		18	25.50		53	57.08	do	Do.
ı church		17	53.48		55	52.88	do	Do.
m-House Square, flagstaff		18	02.82		55	26.63	do	Do.
lhouse cupola		18	35.19		53	26.32	do	Do.
Wharf light-house (1873)		17	33.82		54	56.49	do	Do.
don:								
Congregational church 2).		21	18.23		05	50.38	do	Do.
d Congregational church 2).		21	26.34		06	06.30	do	Do.
-house (1835–1886)		18	59.99		05	24.68	do	Do.
spire		19	39.00		11	35.04	do	Do.
n		23	53.85		19	39.56	do	Do.
		26	41.35		57	30.62	do	Do.
		17	35.88		54	15.85	do	Do.
astonbury, Congregational		42	31.86		36	31.92	do	Do.
ilford church spire		22	05.84		43	39.44	do	Do.
ven church spire		23	12.97		51	42.66	do	Do.
ll		22	36.82		49	18.43	do	Do.
llingworth, Congregational (1836–1882).		21	47.07		33	58.07	do	Do.
nd Rock		19	00.52		50	17.48	do	Do.
innipiac		19	28.71		53	20.77	do	Do.
effield College:								
r observatory in college ınds.		18	47.00		55	30.89	do	Do.
chimney lightning rod		18	45.96		55	31.67	do	Do.
tchhouse		16	44.40		55	09.49	do	Do.
church		32	57.64		05	46.78	do	Do.
		18	59.61		20	33.18	do	Do.
		23	48.29		05	24.44	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Orange	41	17	58.04	72	57	54.16	C. & G. S	Rept. '88.
Oyster Point		16	58.47		55	48.98	do	Do.
Oyster River Point		14	02.20		58	33.11	do	Do.
Paddock		16	25.92		34	13.68	do	Do.
Page		19	22.92		48	11.92	do	Do.
Paphro		28	40.41		31	30.35	do	Do.
Park church		32	07.87		04	55.05	do	Do.
Peak		57	32.48		44	24.02	G. S	Bull. 122.
Peck street		19	02.44		53	19.01	C. & G. S	Rept. '88.
Penfield Hill		34	54.05		34	29.77	do	Do.
Pettipaug spire		21	05.94		24	53.38	do	Do.
Pilgrim		19	49.60		20	27.46	do	Do.
Pine		21	59.66		58	25.68	do	Do.
Hill		36	37.64		32	11.98	do	Do.
Island		20	26.14		20	50.95	do	Do.
Street		18	47.78		53	16.56	do	Do.
Pinnacle		18	58.65		51	00.62	do	Do.
Plant Hill		16	39.10		50	29.84	do	Do.
Pole		27	14.52		07	41.57	do	Do.
Pond Lily Paper Mill, chimney		20	06.59		58	35.00	do	Do.
Pond Rock		17	40.04		51	24.46	do	Do.
Poorhouse flagstaff		21	08.51		06	41.80	do	Do.
Poplar		16	30.49		50	22.65	do	Do.
Poplar, 2 (1882)		16	30.47		50	22.65	do	Do.
Portland:								
White steeple		34	53.00		38	03.12	do	Do.
Congregational church		35	28.58		37	29.55	do	Do.
Schneider's factory smokestack		34	14.78		37	45.68	do	Do.
Post		13	22.33		59	40.60	do	Do.
Post Hill		40	15.15		20	19.64	G. S	Bull. 122.
Prindle		16	05.12		59	32.63	C. & G. S	Rept. '88.
Prospect church spire		30	07.69		58	41.88	do	Do.
Quaker		22	46.37		06	26.05	do	Do.
Quarry		24	26.72		25	17.11	do	Do.
Do		15	26.37		43	59.37	do	Do.
Quartz Hill		22	00.41		59	41.37	do	Do.
Rabbit Rock		20	31.63		51	12.19	do	Do.
Red and White		17	07.05		53	49.07	do	Do.
Road		24	18.51		56	40.25	do	Do.
Robinson Hill		47	43.61		04	48.29	G. S	Bull. 122.
Rock		31	10.98		04	13.18	C. & G. S	Rept. '88.
Rocky Ledge		18	30.73		15	01.16	do	Do.
Rogers, Smith & Co., cupola		18	09.46		54	38.76	do	Do.
Round Hill House		17	41.00		58	23.73	do	Do.
Sachem Head		16	58.58		43	30.78	do	Do.
Salmon		28	19.33		28	00.52	do	Do.
Sandford (1839)		28	07.64		57	13.78	do	Do.
Sandford Az. Station (1862)		27	42.80		56	59.30	do	Do.
Sandford Lat. Station (1862)		27	43.19		56	59.85	do	Do.
Sandy Point		16	04.16		55	35.10	do	Do.
Saybrook:								
Beacon (1882-83)		16	07.50		20	18.70	do	Do.
Light-house (1835-36)		16	17.65		20	36.94	do	Do.
Breakwater light-house (1886)		15	47.60		20	35.45	do	Do.
Congregational church (1861-1883)		17	12.20		22	32.29	do	Do.
Light-house (1861-1886)		16	17.39		20	36.86	do	Do.
Schoolhouse		30	54.32		04	32.55	do	Do.
Schoolhouse Hill		39	31.32		40	52.91	do	Do.
Selden		24	20.24		24	02.76	do	Do.
Selden Neck		23	43.05		24	54.72	do	Do.
Selden North		30	50.16		31	30.07	do	Do.
Setauket		19	36.49		46	32.11	do	Do.
Shailerville, Baptist church		27	55.48		28	47.96	do	Do.
Shaler		27	47.93		29	00.93	do	Do.
Shell Heap		18	43.58		52	58.94	do	Do.
Shipman		40	16.02		38	14.37	do	Do.
Simpson		37	58.08		36	47.82	do	Do.
Slate Hill		22	28.22		58	52.19	do	Do.
Slaughterhouse, east cupola		19	17.26		53	33.27	do	Do.
Smith		30	32.05		30	55.32	do	Do.
Smith Landing		29	07.76		30	26.30	do	Do.
Soapstone		57	32.50		24	49.30	G. S	Bull. 122.
South Pond Rock		17	05.89		51	49.89	C. & G. S	Rept. '88.
Southwest Ledge, light-house (1875-1882).		14	04.14		54	45.08	do	Do.
Sperry		21	06.84		59	14.60	do	Do.
Spink Hill		16	37.70		50	58.79	do	Do.
Steens		37	19.70		40	47.26	do	Do.
Stone Hill		19	54.15		24	11.31	do	Do.
Storr Monument		48	52.51		15	33.98	do	Do.
St. Francis Orphan Asylum, cupola		19	43.78		55	07.62	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	72°-73°		
	° ′ ″	° ′ ″		
r Creek	41 16 23.30	72 45 21.29	C. & G. S	Rept. '88.
rloaf	22 31.86	43 54.97	do	Do.
Hill	30 09.02	33 31.89	do	Do.
t Hill	40 15.88	13 49.55	G. S	Bull. 122.
tt	48 41.64	47 57.19	C. & G. S	Rept. '88.
r	40 19.05	35 25.38	do	Do.
raph	17 09.92	55 52.59	do	Do.
raph rod	18 56.81	53 14.72	do	Do.
er	31 55.85	35 07.14	do	Do.
pson	19 42.10	49 58.20	do	Do.
	31 04.44	04 05.33	do	Do.
Post	15 27.60	43 54.11	do	Do.
	32 40.58	37 37.73	do	Do.
tree	21 47.87	54 00.68	do	Do.
Island	15 57.89	36 08.32	do	Do.
Island, 2 (1882)	15 57.09	36 08.35	do	Do.
Tree Island	17 40.82	09 11.98	do	Do.
Tree Island, 2 (1882)	17 39.16	09 11.03	do	Do.
Tree Island House	17 40.18	09 11.37	do	Do.
Hill	28 14.90	05 27.62	do	Do.
ville church	26 17.86	06 27.17	do	Do.
Pole Hill	27 14.38	07 41.13	do	Do.
ar Hill	25 27.37	03 21.53	do	Do.
worth tower (1875)	49 25.60	47 56.82	do	Do.
inicut	23 43.60	25 45.92	do	Do.
n Island	28 06.55	04 08.33	do	Do.
ey	29 42.40	32 02.09	do	Do.
gford church spire	27 15.75	49 08.42	do	Do.
House	15 14.99	40 39.13	do	Do.
	17 20.00	55 40.34	do	Do.
1 (1869)	23 28.90	05 45.30	do	Do.
2 (1869)	24 04.40	05 55.66	do	Do.
3 (1869)	24 26.68	05 54.99	do	Do.
rook, Congregational church -1882).	17 10.64	27 00.73	do	Do.
eld	33 31.17	42 34.15	do	Do.
Haven spire (1833)	16 17.67	57 02.98	do	Do.
Haven:				
y Works, chimney	16 46.26	56 25.12	do	Do.
ngregational church (1876)	16 17.48	57 01.88	do	Do.
Peak	33 34.90	50 38.78	G. S	Bull. 122.
Rock	19 56.42	57 42.61	C. & G. S	Rept. '88.
Rock (1882)	15 12.75	32 01.71	do	Do.
Rock, 2 (1871)	19 56.42	57 42.00	do	Do.
Rock North	22 58.88	57 44.84	do	Do.
Rock North, 2 (1875)	23 21.94	57 34.93	do	Do.
Rock Ridge	25 07.75	57 18.83	do	Do.
side church	31 19.35	04 58.70	do	Do.
lle	19 35.65	58 16.80	do	Do.
thodist Episcopal church	19 42.80	57 41.27	do	Do.
rsfield:				
gstaff (1875)	42 45.90	39 10.97	do	Do.
ite Congregational church	42 46.70	39 09.60	do	Do.
ns	21 18.95	31 09.57	do	Do.
k	21 37.88	23 28.60	do	Do.
	29 44.08	04 28.80	do	Do.
ester Hill	19 28.04	55 18.96	do	Do.
orks	17 56.08	53 43.65	do	Do.
llege, middle spire	18 30.12	55 44.46	do	Do.
bservatory:				
ter peg	19 28.48	55 19.16	do	Do.
t dome apex	19 28.48	55 18.06	do	Do.
Hill	24 32.06	55 09.79	do	Do.
	41°-42°	73°-74°		
	41 09 03.40	73 19 36.48	do	Do.
us, tower of Indian Harbor	00 37.27	37 09.36	do	Do.
	18 29.29	31 20.28	do	Do.
ill	12 49.82	28 41.68	do	Bull. 122.
ill, 2 (1882)	12 49.82	28 41.71	do	Rept. '88.
ill	20 40.42	11 06.77	do	Do.
Point	07 41.46	14 33.38	do	Do.
and	03 19.80	26 01.76	do	Do.
t	04 24.94	28 23.74	do	Do.
	16 40.12	06 05.81	do	Do.
urn	21 35.34	11 43.14	do	Do.
Rock (1833)	08 38.92	12 57.24	do	Do.
Rock, 2 (1834)	08 35.04	12 58.13	do	Do.
Rock:				
t-house (1833-1835)	08 32.58	13 04.09	do	Do.
con	07 14.36	13 03.79	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
Booth	41	16	42.43	73	11	06.28	C. & G. S	Rept. '88.
Bradley		10	53.83		17	30.54	do	Do.
Bridgeport:								
Harbor light-house (1882)		09	24.18		10	49.38	do	Do.
Inner northeast beacon (1833-1882)		09	58.88		10	35.60	do	Do.
Outer southwest beacon (1833-1882)		09	47.01		10	45.86	do	Do.
Second Congregational church spire (1882).		10	32.60		11	24.26	do	Do.
First Congregational church spire (1882).		10	37.60		11	26.42	do	Do.
First Presbyterian church spire (1882).		10	29.30		11	42.32	do	Do.
Harbor light-house (1853)		09	26.26		10	48.40	do	Do.
Middle steeple (1833)		10	34.76		11	24.83	do	Do.
North steeple (1833)		10	37.64		11	26.53	do	Do.
St. Augustine Catholic church spire (1882).		10	48.70		11	45.00	do	Do.
South steeple (1833)		10	32.51		11	23.95	do	Do.
Brown		10	01.82		25	47.64	do	Do.
Brushy Ridge		09	24.29		29	00.90	do	Do.
Burns Point		12	37.34		03	01.45	do	Do.
Calf Pasture Island		04	56.36		23	03.57	do	Do.
Canal		05	58.33		22	26.19	do	Do.
Center Redding		19	00.62		22	57.91	do	Do.
Charles Island, poplar		11	28.16		03	18.96	do	Do.
Chestnut		14	13.50		14	14.61	do	Do.
Chestnut Tree Hill		26	26.53		06	42.48	do	Do.
Chimon Island (1834)		04	03.24		23	29.30	do	Do.
Chimon Island, 2 (1882)		04	04.78		23	29.37	do	Do.
Close		04	47.84		38	03.75	do	Do.
Cobble		46	37.15		30	04.53	do	Do.
Cockenoes		05	01.42		21	20.76	do	Do.
Cockenoes Island, 2 (1882)		05	01.40		21	21.08	do	Do.
Collins		26	20.28		00	44.90	do	Do.
Connecticut		57	28.35		29	37.59	do	Do.
Connecticut Monument		57	30.00		29	37.56	do	Do.
Copp Island (1834-1885)		03	34.41		23	15.48	do	Do.
Coram		17	52.72		05	04.11	do	Do.
Cronch		17	08.85		25	56.32	do	Do.
Cumpo (1834)		06	50.04		21	00.52	do	Do.
Cumpo, 2 (1882)		06	49.23		20	58.11	do	Do.
Danbury, Congregational church (1864).		23	30.87		27	11.87	do	Do.
Davenport		07	34.72		31	42.73	do	Do.
Dead Tree Hill		17	13.17		18	59.50	do	Do.
Dorlon's Hotel, cupola		05	13.21		24	07.70	do	Do.
Dye works, southwest chimney		02	52.30		30	15.60	do	Do.
East Bridgeport, Catholic church spire (1884).		10	54.55		10	44.72	do	Do.
Easton spire (1839)		15	01.63		18	10.59	do	Do.
Ellsworth		48	07.78		27	12.47	do	Do.
Fairfield		09	23.92		15	33.68	do	Do.
Congregational church spire (1882)		08	35.56		15	02.06	do	Do.
Episcopal church spire (1882)		08	32.58		15	02.89	do	Do.
Presbyterian church spire (1833)		08	35.99		15	01.57	do	Do.
Ferris, cupola of "Old Greenwich Pt. House."		01	04.14		33	49.71	do	Do.
Field Point		00	06.50		37	37.92	do	Do.
Fish Island		02	54.35		27	28.32	do	Do.
Frost Point		06	55.52		18	34.71	do	Do.
Frost Point, 2 (1882)		06	55.46		18	33.78	do	Do.
Good Hill		32	55.52		15	36.75	do	Bull. 122
Goodridge		19	41.89		18	49.19	do	Rept. '88.
Goodsall		15	58.50		24	55.52	do	Do.
Gorham		11	00.29		23	45.68	do	Do.
Goshen Center Congregational church (1865).		49	54.11		13	30.74	do	Do.
Gould		10	58.50		16	38.38	do	Do.
Great Hill, east		21	53.66		07	01.36	do	Do.
Green Farms, spire (1834)		08	09.62		19	50.77	do	Do.
Green Ledge Spindle		02	36.35		25	22.57	do	Do.
Greenfield		11	32.29		17	18.69	do	Do.
Church spire (1882)		10	36.82		17	34.19	do	Do.
Church spire (1833)		10	37.06		17	34.21	do	Do.
Greenwich Point		00	09.90		34	17.40	do	Do.
Greenwich Point, 2 (1882)		00	14.20		34	26.13	do	Do.
Gunn		13	56.58		04	57.96	do	Do.
Handford		09	06.74		22	27.02	do	Do.
Hawley		19	17.46		14	55.50	do	Do.
Hickcox		23	12.43		00	13.53	do	Do.
Hickcox (1839-1876)		23	12.75		00	13.75	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
igh Ridge	41	16	24.20	73	30	09.06	C. & G. S.	Rept. '88.
itchcock		48	04.49		29	42.13	do	Do.
obby		03	35.28		36	59.41	do	Do.
ooper		24	56.46		00	03.97	do	Do.
orseneck, First Congregational church spire.		02	07.19		37	24.64	do	Do.
orseneck, spire (1833)		02	06.08		37	24.46	do	Do.
ospital		11	21.21		10	00.76	do	Do.
unt		18	24.28		32	54.32	do	Do.
y		52	18.50		13	27.93	do	Rept. '85.
ackson		15	06.59		17	00.41	do	Rept. '88
ohnson		10	04.88		10	04.08	do	Do.
ensies Point		07	33.24		16	22.52	do	Do.
ambert		48	10.94		30	13.25	do	Do.
itchfield:								
Congregational church (1865)		44	52.26		11	18.49	do	Do.
Episcopal church (1865)		44	46.21		11	19.29	do	Do.
af Hill		19	34.70		29	55.06	do	Do.
ckwood		05	34.61		29	04.16	do	Do.
ne Chimney		09	18.30		13	05.11	do	Do.
ng Neck		02	11.10		28	40.88	do	Do.
ng Neck, 2 (1882)		02	10.41		28	41.85	do	Do.
Donald		13	08.44		09	11.26	do	Do.
ad (1864)		18	07.34		32	53.13	do	Do.
rwin		14	09.09		19	57.60	do	Do.
les Fish Works chimney		12	07.60		02	18.20	do	Do.
lford		13	26.43		01	15.51	do	Do.
Congregational spire (1833-1884)		13	36.63		03	33.03	do	Do.
Episcopal church spire		13	27.23		03	27.73	do	Do.
Old spire with gilt ball		13	37.46		03	25.97	do	Do.
Point		10	42.67		05	51.92	do	Do.
l Hill		08	49.37		16	42.32	do	Do.
hawk		49	16.80		17	49.50	G. S.	Bull. 122.
nroe:								
Belfry (1839)		19	55.38		12	24.48	C. & G. S	Rept. '88.
Tall spire (1839)		19	58.84		12	26.90	do	Do.
ose Hill, east		24	05.57		06	55.36	do	Do.
ose Hill, Fairfield County		19	11.73		12	06.09	do	Do.
unt Tom		41	36.43		16	25.54	do	Bull. 122.
h		06	04.80		25	41.60	do	Rept. '88.
wton		25	51.86		02	04.58	do	Do.
hols		08	49.10		08	10.72	do	Do.
field, spire (1834)		12	10.31		22	40.51	do	Do.
th Milford, spire		16	42.20		01	35.36	do	Do.
ton		03	16.70		30	53.07	do	Do.
ton Point		03	19.32		26	19.40	do	Do.
walk, north spire (1834)		07	14.62		24	28.56	do	Do.
walk Islands, light-house (1834)		02	55.43		25	10.52	do	Do.
walk Islands, light-house (1882-85).		02	55.74		25	10.53	do	Do.
walk River beacon (1882)		04	23.70		24	22.10	do	Do.
walk, south spire (1834)		07	07.66		24	30.78	do	Do.
Farms		14	53.06		09	18.82	do	Do.
orne		23	37.47		12	44.87	do	Do.
ner		03	40.87		34	06.19	do	Do.
ick		17	36.24		31	18.62	do	Do.
ement		11	37.34		17	17.35	do	Do.
k		22	54.11		03	30.47	do	Do.
Hill		40	02.37		26	08.97	do	Do.
ield Reef, light-house (1882)		07	01.57		13	21.01	do	Do.
et Ridge		19	29.41		27	11.43	do	Do.
Creek Point (1833)		07	06.34		15	42.24	do	Do.
Creek Point, 3 (1882)		07	07.37		15	42.99	do	Do.
Swamp Hill		21	09.10		16	29.21	do	Do.
l Point		12	41.24		00	38.20	do	Do.
ton, stone church (1865)		40	37.16		22	22.82	do	Do.
ton, white spire (1865)		41	05.78		18	42.98	do	Do.
pect Hill		58	45.11		23	06.28	do	Do.
Island		03	32.83		24	12.52	do	Do.
ling Ridge		18	11.10		21	12.32	do	Do.
ling, spire (1839)		18	49.68		21	04.34	do	Do.
efield:								
piscopal church (1865)		16	49.50		29	59.05	do	Do.
resbyterian church (1839)		16	30.47		29	52.89	do	Do.
s		24	44.15		07	48.73	do	Do.
		00	06.57		37	41.22	do	Do.
house Hill		23	04.94		08	22.13	do	Do.
d Hill		06	13.17		40	25.79	do	Do.
d Hill, 2 (1882)		06	13.02		40	26.23	do	Do.
atuck		07	28.00		19	23.08	do	Do.
eld		08	20.92		34	52.98	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
Seaside Park, soldiers' monument	41	09	41.58	73	11	11.92	C. & G. S.	Rept. '88.
Sheffield Island		02	50.20		25	21.73	do	Do.
Sheffield, west		02	52.01		25	27.59	do	Do.
Sherwood		12	09.04		13	24.07	do	Do.
Shippan		01	32.23		31	10.65	do	Do.
Shippan Point		01	12.22		31	24.38	do	Do.
Old chimney		01	28.00		31	12.02	do	Do.
Skagerat		24	46.21		03	08.84	do	Do.
Southport:								
Congregational church spire (1882).		08	06.28		17	12.90	do	Do.
Episcopal Church spire (1882)		08	00.25		17	16.84	do	Do.
Inner beacon (1882)		07	33.45		17	15.45	do	Do.
Outer beacon (1882)		07	18.86		17	15.72	do	Do.
South Whitehall		19	12.91		07	56.23	do	Do.
Spindle		00	21.54		36	44.77	do	Do.
Stamford:								
Baptist church spire (1882)		03	18.68		32	21.29	do	Do.
Congregational church spire (1882).		03	08.94		32	24.22	do	Do.
Harbor, light-house (1882–1885)		00	49.21		32	34.74	do	Do.
Northeast spire (1834)		03	14.76		32	03.19	do	Do.
Southwest spire (1834)		03	12.78		32	21.98	do	Do.
Stanwick		06	33.32		36	51.06	do	Do.
Star		18	46.66		27	39.18	do	Do.
Stratford:								
Beacon (1881-1884)		09	47.11		06	14.89	do	Do.
Beacon (1833)		09	47.05		06	14.82	do	Do.
Congregational church spire (1884).		11	33.20		07	51.82	do	Do.
Episcopal church spire (1884)		11	18.68		07	50.06	do	Do.
Hill		13	08.36		09	10.79	do	Do.
Point		09	28.72		07	06.12	do	Do.
Point, light-house (1881-1885)		09	07.22		06	13.47	do	Do.
Point, light-house (1833)		09	07.24		06	13.18	do	Do.
Spire (1833)		11	19.44		07	50.17	do	Do.
Do		11	32.84		07	51.56	do	Do.
St. John		06	58.31		25	31.86	do	Do.
Summerville		20	32.78		03	28.56	do	Do.
Tashua		15	37.84		15	01.33	do	Do.
Church (1839)		17	13.31		15	38.87	do	Do.
Tavern Island		03	39.14		25	20.80	do	Do.
Flagstaff (1882)		03	39.01		25	20.82	do	Do.
Thorp		07	59.10		19	09.00	do	Do.
Trumbull		17	46.94		15	44.52	do	Do.
Van, cupola of Shippan Point House		01	40.87		31	10.84	do	Do.
Wallack		02	11.49		30	22.80	do	Do.
Warren Observatory, flagstaff (1864)		43	37.45		21	13.14	do	Do.
Watchhouse on rock, west gablo		02	23.64		29	21.98	do	Do.
Webb		06	53.01		34	09.84	do	Do.
Wells		14	18.20		07	03.23	do	Do.
West Marsh		04	46.56		24	36.24	do	Do.
West Rocks		08	06.78		24	55.06	do	Do.
Wheeler		15	13.48		19	41.40	do	Do.
Whitehall church (1839)		20	02.80		08	52.37	do	Do.
Wilson Point, depot cupola		03	46.65		25	45.73	do	Do.
Woodbridge:								
Pointed spire		21	14.63		00	48.72	do	Do.
Round spire		21	17.81		00	46.17	do	Do.
Wooster Mountain		21	03.98		29	18.14	do	Bull. 122.
Great Captain Island:	40°-41°			73°-74°				
Light-house (1882–1885)	40	58	57.10	73	37	26.40	do	Rept. '88.
Light-house (1834)		58	57.18		37	26.50	do	Do.
Little Captain Island		59	24.93		36	31.01	do	Do.
Little Captain Island, 2 (1882)		59	24.97		36	31.10	do	Do.
Little Captain Island, 3 (1882)		59	19.97		36	38.95	do	Do.
Mead		59	52.00		39	03.26	do	Do.

NEW YORK.

	45°-46°			74°-75°				
	°	′	″	°	′	″		
Massena Point, triangulation station	45	00	01.67	74	46	11.79	Engr. Corps.	Rept. '76.
	44°-45°			73°-74°				
Bald Peak	44	06	13.00	73	29	15.00	C. & G. S	Do.
Barber Point, light-house		09	15.84		24	17.39	do	Do.
Bigelow		26	54.12		28	09.62	do	

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			73°-74°				
	°	′	″	°	′	″		
lueberry Hill	44	00	15.33	73	33	58.33	C. & G. S	
oquet River Point		21	35.67		21	20.54	do	
atamount		27	34.28		52	21.76	do	
heever		04	54.05		27	02.84	do	
linton Mills chimney		57	33.74		52	58.41	G. S	
herubusco		57	15.63		55	15.03	do	Bull. 122.
rab Isle		39	54.51		25	02.09	C. & G. S	
rown Point light-house		01	47.69		25	19.24	do	
umberland Point		41	34.43		23	28.99	do	
annemora		44	30.04		42	57.60	do	Do.
unn		49	40.85		24	10.67	do	
iant of the Valley		09	40.39		43	14.71	do	
agar		42	52.42		23	22.12	do	
aseltine		49	38.34		55	56.95	G. S	Do.
endrick		00	49.62		27	29.20	C. & G. S	
urricane		14	07.23		42	38.09	do	
igonier Point		24	53.04		21	55.17	do	
yon, 2		42	16.74		51	48.74	do	Do.
acomb		02	48.59		46	58.66	do	
cIntyre, summit		08	37.00		59	14.00	do	
oore		57	53.71		51	36.52	G. S	Do.
ount Dix		04	54.51		47	12.22	C. & G. S	
ount Marcy		06	46.04		55	28.99	do	
oke-a-moonshine		24	06.31		30	48.83	do	
ams Head		46	45.28		22	50.78	do	
and		45	28.87		36	43.99	do	
elden		19	30.98		21	08.48	do	
plit Rock Point		15	54.98		19	44.31	do	
rembleau Point		31	04.44		23	09.82	do	
est Hill		51	18.11		58	31.08	G. S	Do.
hiteface		21	56.99		54	12.77	C. & G. S	
	44°-45°			75°-76°				
lexandria	44	19	38.90	75	55	23.40	L. S	Final Rept.
Thousand Island House		20	15.20		55	16.40	do	Do.
oundary post No. 2, Franklin County		59	58.20		39	32.20	do	Do.
rook Point		36	54.40		36	38.00	do	Do.
uckminster		01	32.44		59	25.80	G. S	Bull. 122.
hapman		33	32.60		41	46.90	L. S	Final Rept.
himney Point		43	55.70		26	56.40	do	Do.
rossover Island light-house		29	48.60		46	44.10	do	Do.
ingham		21	19.00		53	04.50	do	Do.
all Dock		32	46.70		42	45.90	do	Do.
yons		25	01.50		49	00.70	do	Do.
iller		14	21.87		45	22.13	G. S	Bull. 122.
orristown Point		35	55.50		38	33.50	L. S	Final Rept.
ak Point		30	56.90		45	13.10	do	Do.
gdensburg:								
East base		42	29.60		27	56.30	do	Do.
West base		42	19.00		28	48.50	do	Do.
Light-house, or A		41	52.30		30	14.50	do	Do.
Light-house, peak of		41	52.30		30	14.00	do	Do.
ach Island		29	27.80		46	07.90	do	Do.
arp		49	07.00		17	40.80	do	Do.
ster Island, light-house		24	50.80		50	41.90	do	Do.
arrowhawk		48	02.80		20	43.30	do	Do.
nken Rock, light-house		20	44.60		54	57.40	do	Do.
ylor		33	05.20		42	23.70	do	Do.
agner		46	25.00		21	43.20	do	Do.
	44°-45°			76°-77°				
pe Vincent	44	07	31.40	76	20	32.10	do	Do.
East base		07	41.60		17	34.70	do	Do.
West base		07	54.00		18	55.30	do	Do.
rlton		10	58.97		17	38.75	do	Do.
ayton:								
Roman Catholic church		14	18.80		05	12.20	do	Do.
South base, Jefferson County		14	04.10		04	34.10	do	Do.
ly		10	03.60		18	35.10	do	Do.
rr farm		14	37.90		03	21.70	do	Do.
is		08	34.20		17	44.00	do	Do.
enadier		02	11.71		22	32.40	do	Do.
indstone		16	04.00		08	57.80	do	Do.
gsback		12	02.20		09	08.10	do	Do.
melia		05	24.76		52	34.78	G. S	Bull. 122.
ck Island light-house		16	49.00		01	02.00	L. S	Final Rept.
eber		06	28.28		00	54.81	G. S	Bull. 122.
bbett Point, light-house		06	02.30		22	15.40	L. S	Final Rept.
olfe		07	31.12		23	19.98	do	Do.
	43°-44°			73°-74°				
mbler	43	05	36.56	73	51	08.73	S. S	Rept. '87.
stin		35	03.78		24	34.98	C. & G. S	

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			73°-74°				
	°	′	″	°	′	″		
Bailey	43	04	09.77	73	39	17.54	S. S	Rept. '87.
Ballston		00	48.00		51	03.00	do	Rept. '83.
Barber		34	46.32		26	02.08	C. & G. S	
Birch		20	18.94		20	11.01	G. S	Bull. 122.
Black Mountain		36	24.30		31	53.90	C. & G. S	
Breed Hill		55	19.37		25	43.27	do	
Brimstone		44	45.28		25	00.49	do	
Crain		32	41.83		57	46.36	do	
Crown Point, south base		58	51.07		25	29.44	do	
Felton Hill		01	05.64		28	10.40	G. S	Do.
Greenwich		07	35.12		31	30.61	C. & G. S	Do.
Jackson		04	41.28		23	59.06	G. S	Do.
Londonville, home lawn flag pole		43	42.91		45	35.78	S. S	Rept. '87.
Mount Tom		41	47.26		24	41.28	C. & G. S	
Prospect		25	17.95		46	04.57	do	Rept. '85.
Rascal		15	39.49		24	15.68	G. S	Bull. 122.
Saratoga		04	07.40		47	22.98	S. S	Rept. '87.
Saratoga Springs:								
Methodist Episcopal church spire		04	49.53		47	16.08	do	Do.
Presbyterian church spire		05	02.55		47	03.99	do	Do.
Catholic church spire		04	35.62		47	14.46	do	Do.
Skeenes		33	26.03		23	48.28	C. & G. S	
Snody		36	50.25		26	26.75	do	
	43°-44°			74°-75°				
Bart Hill	43	07	50.07	74	53	24.38	S. S	
Barto		07	50.07		53	24.37	do	Rept. '87.
Broadalbin:								
Baptist church cupola		03	28.94		11	55.19	do	Do.
Methodist Episcopal church, tower.		03	27.11		11	59.81	do	Do.
Clip Hill		03	04.06		25	29.90	do	Do.
County line, stone No. 88, between Fulton and Montgomery counties.		01	09.00		39	42.00	do	Rept. '83.
Fairfield:								
Academy		08	18.12		54	47.24	do	Rept. '87.
Methodist Episcopal church		08	13.52		54	51.99	do	Do.
Presbyterian church or town hall		08	18.74		54	59.60	do	Do.
Protestant Episcopal church		08	09.20		54	40.43	do	Do.
Galway		04	05.30		02	35.49	do	Do.
Gloversville:								
Baptist church spire		02	56.16		20	49.46	do	Do.
Collins Bros.' building, flag pole		03	04.90		20	44.19	do	Do.
Congregational church, white spire.		03	03.19		20	39.82	do	Do.
First Methodist Episcopal church spire.		03	06.88		20	48.14	do	Do.
First Presbyterian church spire		03	02.34		20	48.38	do	Do.
Gore		40	15.10		02	58.49	C. & G. S	
Hamilton		24	41.82		22	00.15	do	
Herkimer		01	37.10		56	55.24	S. S	Do.
Court-house		01	44.56		59	21.96	do	Do.
Dutch Reformed church		01	44.55		59	24.56	do	Do.
Methodist Episcopal church		01	32.49		59	20.53	do	Do.
Schoolhouse		01	41.17		59	13.32	do	Do.
Johnstown:								
Court-house dome		00	24.01		22	30.02	do	Do.
Fire department house pinnacle		00	18.77		22	29.15	do	Do.
First Baptist church spire		00	22.23		22	32.03	do	Do.
Martin Kennedy's house pinnacle		00	10.32		22	28.00	do	Do.
Presbyterian church spire		00	16.50		22	23.65	do	Do.
St. Patrick's Roman Catholic church spire.		00	15.50		22	09.48	do	Do.
St. Paul's Lutheran church spire		00	28.56		22	17.33	do	Do.
Sir W. Johnson hotel flag pole		00	24.97		22	29.41	do	Do.
United Presbyterian church spire		00	26.71		22	24.17	do	Do.
Kingsboro		05	05.53		21	28.15	do	Do.
Presbyterian church tower		04	01.70		20	13.46	do	Do.
Schoolhouse cupola		03	57.22		20	12.78	do	Do.
Little Falls		02	59.51		51	38.18	do	Do.
Baptist church		02	35.75		51	26.27	do	Do.
Methodist Episcopal church		02	34.66		51	28.87	do	Do.
Presbyterian church		02	43.17		51	32.62	do	Do.
Roman Catholic church (new), Church of the Assumption.		02	37.73		51	12.15	do	Do.
Roman Catholic church (old)		02	41.45		51	08.19	do	Do.
Mayfield:								
Methodist church tower (white)		06	19.48		15	50.78	do	Do.
Presbyterian church, white, four-pinnacled tower.		06	19.80		15	48.70	do	Do.
Middle Sprite, Free Methodist church		07	15.82		38	20.78	do	Do.
North Galway, Christian church		03	57.19		03	15.13	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			74°-75°				
	°	′	″	°	′	″		
enheim, Methodist Episcopal urch.	43	04	23.17	74	41	36.38	S. S	Rept. '87
th Center, United Presbyterian urch tower.		01	08.04		11	26.69	do	Do.
al Hill		05	08.67		31	07.95	do	Do.
ohnsville		00	24.92		40	12.25	do	Do.
race Protestant Episcopal church cross.		00	01.57		40	46.08	do	Do.
choolhouse cupola		00	03.23		40	35.36	do	Do.
y Mountain		41	55.53		23	13.45	C. & G. S	
ulator		27	36.03		20	24.94	do	
n:								
ethodist Episcopal church		02	21.23		42	52.95	S. S	Do.
nion church		02	22.56		42	53.42	do	Do.
der Whacken		53	53.74		05	46.96	C. & G. S	
ler		01	07.65		39	02.59	S. S	Do.
t Galway:								
ethodist Episcopal church		00	23.24		06	08.42	do	Do.
resbyterian church		00	20.20		06	07.96	do	Do.
orth Presbyterian church tower		00	22.00		06	09.00	do	Do.
cotch Presbyterian church		00	14.09		06	09.45	do	Do.
Perth		00	30.60		16	18.44	do	Do.
	43°-44°			75°-76°				
	43	05	18.17	75	48	06.64	do	Do.
oy		23	14.20		55	07.54	do	Do.
ton		53	52.46		55	41.02	C. & G. S	Bull. 122.
geport, Methodist Episcopal rch.		09	23.09		58	12.44	S. S	Rept. '87.
er		03	55.89		39	59.75	do	Do.
stota		04	20.64		44	20.44	do	Do.
aptist church		04	28.62		45	08.22	do	Do.
ree church		04	41.71		45	11.20	do	Do.
ethodist Episcopal church		04	51.81		45	19.90	do	Do.
		51	37.67		46	56.10	C. & G. S	Bull. 122.
enango Station, Free Methodist rch.		05	15.34		52	22.93	S. S	Rept. '87.
hville:								
erman Lutheran church (east)		11	30.42		34	16.77	do	Do.
erman Lutheran church (west)		11	27.19		34	21.61	do	Do.
ven-Day Baptist church		11	21.95		34	32.10	do	Do.
land, Protestant Episcopal rch.		14	02.25		52	54.64	do	Do.
n		03	17.00		01	37.44	do	Do.
on		01	04.01		46	02.07	do	Do.
ield Corners:								
ptist church		06	51.15		12	08.17	do	Do.
Peter's church, Roman Catholic		06	58.93		12	37.54	do	Do.
eux		04	46.71		14	54.11	do	Do.
mville:								
ptist church		07	05.65		40	10.10	do	Do.
rman Catholic church		07	09.58		40	07.96	do	Do.
		01	25.86		55	10.83	do	Do.
		01	43.99		33	19.38	do	Do.
reek, Union church		13	12.59		41	56.49	do	Do.
ce C. S		23	14.49		39	36.30	do	Do.
Corners		13	09.86		20	06.10	do	Do.
e		51	22.53		48	53.76	C. & G. S	Bull. 122.
ton College, chapel dome		03	07.13		24	21.29	S. S	Rept. '87.
sville, Presbyterian church		10	34.71		38	40.62	do	Do.
		00	36.00		01	52.39	do	Do.
esbyterian church		00	48.03		02	20.34	do	Do.
Mary's church, Roman Catholic		00	41.58		01	45.18	do	Do.
n		57	16.05		50	33.36	C. & G. S	Bull. 122.
n		05	54.86		01	41.39	S. S	Do.
ille		04	19.54		56	16.23	do	Rept. '87.
thodist Episcopal church		04	31.00		57	04.85	do	Do.
y		41	47.37		59	55.94	C. & G. S	Bull. 122.
s Station, Methodist Episcopal ch.		04	41.94		59	55.74	S. S	Rept. '87.
		02	51.54		10	24.00	do	Do.
k:								
tch Reformed church		00	36.42		00	19.83	do	Do.
thodist Episcopal church		00	43.31		00	10.12	do	Do.
iversalist church		00	39.79		00	29.48	do	Do.
ork Mills Methodist Episcopal ch.		06	13.01		17	36.79	do	Do.
Gage, Union church		13	23.17		07	12.32	do	Do.
Manlius P. O.:								
ptist church		05	57.91		58	22.11	do	Do.
thodist Episcopal church		06	01.22		58	20.75	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			75°-76°				
Oneida:	°	′	″	°	′	″		
Baptist church	43	05	37.29	75	39	06.25	S. S	Rept. '87.
Opera-house dome		05	44.29		39	10.45	do	Do.
Presbyterian church		05	38.45		39	06.91	do	Do.
Castle Presbyterian church		04	46.07		38	06.51	do	Do.
Perryville, Protestant Episcopal church.		00	24.81		47	57.27	do	Do.
Prospect		02	15.39		26	40.36	do	Do.
Quality Hill, Presbyterian church		04	03.39		46	33.31	do	Do.
Ridgeville, Presbyterian church		07	57.27		47	28.96	do	Do.
Rome		14	03.00		27	58.13	do	Do.
Baptist church		12	58.74		27	33.25	do	Do.
First Methodist Episcopal church		12	59.06		27	30.77	do	Do.
German Catholic church		12	48.27		27	33.95	do	Do.
Presbyterian church		12	49.47		27	23.37	do	Do.
St. Joseph's church (Roman Catholic).		12	28.22		27	44.19	do	Do.
Welsh Presbyterian church		12	52.61		27	33.22	do	Do.
Russia Union church		15	28.76		04	47.63	do	Do.
Schuyler		09	43.94		06	59.12	do	Do.
Starr		20	42.20		14	59.31	do	Rept. '87.
Thomas		34	36.42		58	54.09	C. & G. S	Bull. 122.
Tyler, Wesleyan Methodist church		05	40.74		54	50.04	S. S	Rept. '87.
Utica:								
City hall, flag pole		06	03.47		13	58.48	do	Do.
First Methodist Episcopal church		06	01.09		14	06.94	do	Do.
First Dutch Reformed church		05	55.60		14	14.59	do	Do.
First Presbyterian church		06	07.33		13	58.95	do	Do.
Grace Protestant Episcopal church.		06	04.41		13	53.36	do	Do.
St. Patrick's church (Roman Catholic).		06	15.36		14	28.33	do	Do.
Trinity Protestant Episcopal church.		06	09.26		13	25.04	do	Do.
Westminster church		06	02.18		14	03.28	do	Do.
Vernon:								
Baptist church		04	47.02		32	31.39	do	Do.
Methodist Episcopal church		04	43.39		32	29.00	do	Do.
Presbyterian church		04	39.73		32	35.09	do	Do.
Unitarian church		04	45.41		32	28.80	do	Do.
Vernon Center:								
Methodist Episcopal church		03	11.21		30	08.94	do	Do.
Presbyterian church		03	11.20		30	05.91	do	Do.
Verona:								
Methodist Episcopal church		08	13.82		34	18.43	do	Do.
Presbyterian church		08	18.71		34	15.85	do	Do.
Vienna		14	49.63		40	47.47	do	Do.
Methodist Episcopal church		14	21.43		42	10.08	do	Do.
Watertown, court-house, northeast corner of cupola.		58	32.88		55	01.95	L. S	Final Rept.
Wampsville, Presbyterian church		04	29.99		42	20.98	S. S	Rept. '87
Westmoreland, Presbyterian church		06	56.61		24	21.34	do	Do.
West Schuyler, Methodist Episcopal church.		05	55.73		09	09.96	do	Do.
Whitesboro, Baptist church		07	23.86		17	34.03	do	Do.
Williams		10	15.18		13	20.90	do	Do.
	43°-44°			76°-77°				
Amboy, Presbyterian church spire	43	04	14.00	76	16	19.00	do	Rept. '83.
Big Sodus, light-house, Wayne County.		16	25.70		59	11.80	L. S	Final Rept
Brayton barn, cupola, west wing		04	14.33		04	47.09	S. S	Rept. '87
Brewerton, west spire of Disciples church.		14	16.21		08	26.26	do	Do.
Carpenter		00	33.93		17	05.36	do	Do
Cassett		00	02.19		11	35.09	do	Do.
Central Square, church spire		17	13.50		08	45.88	do	Do.
Chestnut Ridge		05	48.66		11	14.77	do	Do.
Clyde, L. S		03	05.07		51	49.34	do	Do.
Collamer		06	04.87		03	28.77	do	Do.
Methodist Episcopal church		06	15.13		03	53.64	do	Do.
Colwell		41	40.56		11	10.78	G. S	Bull. 122.
Constantia, Presbyterian church		14	55.00		00	11.00	S. S	Rept. '83.
Cooper		57	48.20		16	41.50	L. S	Bull. 122.
Davison		03	07.41		17	04.12	S. S	Rept. '87.
Deuel		54	23.90		12	29.30	do	
Draper		03	02.67		12	10.75	do	Do.
Dyke		31	30.54		14	24.76	G. S	Bull. 122.
Fairmount		02	36.75		15	22.68	S. S	Rept. '87.
Fayetteville:								
Presbyterian church		01	45.50		00	27.09	do	Do.
Protestant Episcopal church		01	45.76		00	25.23	do	Do.
Roman Catholic church		01	47.21		00	16.20	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			76°-77°				
	°	′	″	°	′	″		
	43	58	05.60	76	12	04.20	L. S	Rept. '87.
n, Falley Academy		19	17.00		24	43.00	S. S	Rept. '83.
o		55	07.60		24	36.10	L. S	Final Rept.
ight-house		53	18.60		26	41.90	do	Do.
ort		11	56.77		32	31.90	do	Do.
es, Methodist Episcopal church		03	07.17		11	23.97	S. S	Rept. '87.
rtsville		18	42.32		17	49.66	do	Do.
on		52	48.90		15	32.80	L. S	Bull. 122.
ne		31	30.80		22	24.20	do	Do.
ton		31	30.30		15	19.20	do	
y		53	04.77		14	09.99	G. S	Do.
ley		07	12.90		18	00.25	S. S	Rept. '87.
pool, Methodist Episcopal rch spire.		06	13.72		12	24.86	do	Do.
is		21	18.46		17	10.37	C. & G. S	Bull. 122.
sville		42	54.41		03	14.61	L. S	Do.
Davis		09	47.34		18	44.36	S. S	Rept. '87.
base, between Jefferson and ego counties.		40	43.61		12	02.03	L. S	
up		00	03.70		21	25.39	S. S	Do.
ous		02	04.24		07	55.56	do	Do.
aga Hill, Presbyterian church		00	12.53		11	00.98	do	Do.
o		26	37.28		30	50.41	L. S	Final Rept.
Do		26	39.57		30	53.55	do	Do.
urt-house		27	26.00		30	22.80	do	Do.
ght-house		27	53.90		30	50.90	do	Do.
ts Harbor, or Horse Island, -house.		56	34.70		06	43.00	do	Do.
Creek		39	06.93		06	08.40	do	Bull. 122.
ood		02	13.45		17	17.22	S. S	Rept. '87.
Star, St. Mary's church		05	15.29		00	08.83	do	Do.
Hill		06	51.54		21	23.62	do	Do.
base		38	05.19		11	51.52	L. S	
Point		50	47.56		17	28.19	do	Final Rept.
ht-house		50	21.60		17	56.80	do	Do.
se:								
st Presbyterian church spire		02	54.73		09	08.26	S. S	Rept. '87.
John's Roman Catholic church pire.		04	06.74		09	28.81	do	Do.
Lucy's Roman Catholic church pire.		02	36.27		09	45.39	do	Do.
		01	14.82		33	29.82	do	Do.
y L. S		13	06.82		36	22.13	do	Do.
	43°-44°			77°-78°				
ort	43	11	28.81	77	56	03.68	L. S	Final Rept.
tist church		12	49.70		56	28.50	do	Do.
ner of lots 5, 8, 11, 14		11	54.00		56	39.30	do	Do.
e, light-house		15	09.80		36	40.20	do	Do.
a L. S		04	03.76		09	37.78	S. S	Rept. '87
e Hill		08	06.47		35	10.67	L. S	
ter:								
r Hall statue		09	22.44		36	51.00	do	Final Rept.
rt-house		09	18.10		36	50.70	do	Do.
ver of waterworks		12	45.80		37	36.70	do	Do.
		14	13.74		04	44.74	do	Do.
ne of Academy		14	08.50		04	09.30	do	Do.
ill		02	10.44		25	23.26	S. S	Rept. '87.
rth		09	22.43		20	01.25	L. S	Final Rept.
a Center:	43°-44°			78°-79°				
tist church spire	43	05	42.49	78	23	22.08	S. S	Rept. '87.
hodist Episcopal church spire		05	45.49		23	19.00	do	Do.
		14	22.65		09	19.67	L. S	Final Rept.
Cemetery, soldier's head on ment.		11	22.75		19	29.76	S. S	Rept. '87.
enter, Presbyterian church		11	06.80		11	41.24	do	Do.
		01	18.05		15	45.63	do	Do.
d Institute, flag pole		00	21.51		11	05.99	do	Do.
s		05	48.63		17	34.41	do	Do.
am's house, center		05	47.67		17	35.01	do	Do.
elby		10	03.45		19	58.83	do	Do.
ent church spire		10	10.87		19	31.20	do	Do.
hodist Episcopal church spire		09	23.65		19	32.30	do	Do.
ls		06	54.61		22	03.90	do	Do.
		05	32.26		08	42.99	do	Do.
hodist Episcopal church spire		04	51.46		11	06.94	do	Do.
byterian church spire		04	58.19		11	11.96	do	Do.
olhouse cupola, district No. 2		05	28.46		09	23.91	do	Do.
		01	22.85		28	58.22	L. S	Final Rept.
		09	42.98		10	33.96	S. S	Rept. '87.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			78°-79°				
	°	′	″	°	′	″		
Kimpton's (S.) barn, west cupola	43	09	30.33	78	11	11.85	S. S	Rept. '87.
Macomber, 302		04	39.34		18	39.60	do	Do.
Macomber's, J. S., house tower		04	38.52		18	41.29	do	Do.
Monument 300		11	09.46		11	40.14	do	Do.
Monument 363		09	50.54		19	31.47	do	Do.
Monument 367		04	57.51		11	12.17	do	Do.
Morganville (L. S.)		00	40.11		02	58.60	do	Do.
Christian church tower		00	13.44		04	35.40	do	Do.
Oakfield		04	05.72		16	25.68	do	Do.
Methodist Episcopal church tower		04	01.90		16	24.05	do	Do.
Presbyterian church tower		04	06.14		16	24.76	do	Do.
Seminary tower		03	55.90		16	09.92	do	Do.
Parker		06	56.40		09	50.49	do	Do.
Pekin		10	14.70		52	31.28	L. S	Final Rept.
Pond		03	35.94		19	38.56	S. S	Rept. '87.
Pumpkin Hill, Baptist church		05	51.89		04	01.41	do	Do.
Pusel		09	56.73		15	47.60	do	Do.
Quaker church, east gable		06	01.20		11	37.72	do	Do.
Ross		10	43.20		21	29.95	do	Do.
Ryan		10	25.76		24	37.39	do	Do.
South Alabama, Baptist church spire		04	23.46		20	07.61	do	Do.
Tall Tree		10	12.80		23	35.66	do	Do.
Thirty-mile Point, light		22	29.60		29	11.80	L. S	Final Rept.
Tonawanda		00	03.84		53	21.91	do	Bull. 122.
Vulgary		06	54.09		12	12.11	S. S	Rept. '87.
Watson's (David) barn, west gable		06	44.77		07	57.59	do	Do.
West Barre, Methodist Episcopal church cupola.		09	07.13		15	11.47	do	Do.
West Shelby, Methodist Episcopal church spire.		09	39.26		26	12.95	do	Do.
Yates, spire of church		20	15.80		23	17.50	L. S	Final Re
	43°-44°			79°-80°				
Fort Niagara, light-house	43	15	42.30	79	03	40.00	do	Do.
Niagara Falls, northeast tower of railroad suspension bridge.		06	34.10		03	26.30	do	Do.
	42°-43°			73°-74°				
Abutment	42	39	15.26	73	44	39.80	S. S	Rept. '87.
Academy Hill		14	37.87		46	36.24	do	Do.
Adams		59	52.82		21	04.00	C. & G. S	Bull. 122.
Adamsville, Methodist Episcopal church.		37	21.66		50	11.36	S. S	Rept. '87.
Albany:								
Academy of the Sacred Heart		37	40.13		40	21.06	do	Do.
Congregational Church spire		38	57.98		45	26.92	do	Do.
Cathedral spire		38	51.31		45	35.55	do	Do.
Dudley Observatory, center of equatorial dome.		39	51.81		45	01.47	do	Do.
First Lutheran church		39	06.88		45	13.25	do	Do.
Fourth Presbyterian church spire		39	20.23		44	57.86	do	Do.
German Roman Catholic church, Our Lady of the Angel.		39	43.30		46	10.07	do	Do.
Sacred Heart Roman Catholic church, North Albany.		40	20.03		44	23.22	do	Do.
St. Patrick's Roman Catholic church spire.		39	50.25		46	17.96	do	Do.
St. Paul's German Evangelical Lutheran church spire.		39	32.36		46	08.89	do	Do.
St. Peter's Protestant Episcopal church spire.		39	02.88		45	15.91	do	Do.
Second Presbyterian church spire.		39	04.44		45	12.24	do	Do.
State Hall, flag pole		39	07.00		45	17.00	do	Rept. '83.
State Street Presbyterian church spire.		39	13.70		45	41.16	do	Rept. '87.
Tabernacle Baptist church spire		39	19.05		45	06.73	do	Do.
Trinity Methodist Episcopal church.		39	18.05		45	56.79	do	Do.
Waterworks chimney		40	22.00		46	42.00	do	Rept. '83.
Waterworks gatehouse pole		40	23.00		46	49.00	do	Do.
Alvord		19	10.52		46	29.39	do	Rept. '87.
Arsenal		43	11.01		42	06.58	do	Do.
Athens:								
Knickerbocker Ice Company's chimney.		15	55.10		48	18.18	do	Do.
Protestant Episcopal church		15	53.99		48	27.82	do	Do.
Reformed church		15	48.08		48	42.28	do	Do.
Schoolhouse cupola, District No. 1		16	15.51		48	16.78	do	Do.
Barren Island		27	51.78		47	09.06	do	Do.
Flag pole		28	05.45		47	11.84	do	Do.
Bailey		24	04.19		46	44.47	do	Do.
Baker		31	48.13		46	00.86	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	'	"	°	'	"		
rounds.	42	38	38.06	73	44	45.52	S. S	Rept. '87.
		39	35.30		43	53.63	do	Do.
		59	58.51		31	40.60	C. & G. S	Bull. 122
		27	44.40		46	04.52	S. S	Rept. '87.
ere Hotel, flag pole		35	54.80		44	18.34	do	Do.
		22	21.63		47	06.24	do	Do.
hem		34	45.94		47	52.86	do	Do.
tch Reformed church, north of ecker Corner.		33	43.29		48	19.78	do	Do.
Rock		15	23.22		48	51.39	do	Do.
t		30	56.93		53	44.91	do	Do.
ill		11	05.64		48	55.51	C. & G. S	
		26	53.12		46	18.60	S. S	Do.
us		22	08.70		47	56.94	do	Do.
ise, east gable		22	11.47		47	58.41	do	Do.
		17	16.86		46	31.75	do	Do.
		25	37.90		47	25.92	do	Do.
a cupola		25	32.73		47	17.79	do	Rept. '87.
nd		24	16.49		47	12.08	do	Do.
s		00	29.27		57	13.95	C. & G. S	Do.
Hills		54	35.82		54	16.45	S. S	Do.
stian church		54	35.64		53	31.54	do	Do.
tist church		54	25.59		53	47.60	do	Do.
ll		42	10.86		44	21.89	do	Do.
d		33	17.93		45	05.28	do	Do.
		34	12.65		59	15.72	do	Do.
n		32	11.22		45	14.92	do	Do.
h Reformed church		31	58.00		45	21.41	do	Do.
ill		32	57.83		45	33.29	do	Do.
treet		44	34.55		41	26.66	do	Do.
s (F. E.) house tower		13	01.37		49	46.74	do	Do.
		30	59.83		45	43.01	do	Do.
lle		34	32.83		57	38.30	do	Do.
h Reformed church spire		34	32.00		57	40.00	do	Rept. '83.
rn flag pole		18	14.98		47	40.20	do	Rept. '87.
s:								
emy		28	23.40		47	55.24	do	Do.
tery, Briggs monument		28	01.78		47	42.39	do	Do.
light-house		28	30.93		47	04.17	do	Do.
flag pole		28	23.00		47	24.00	do	Rept. '83.
Roman Catholic church		46	27.15		41	57.95	do	Rept. '87.
		24	39.88		47	28.40	do	Do.
reek		35	10.87		45	13.76	do	Do.
		36	54.35		46	15.03	do	Do.
nan		37	02.04		59	20.68	do	Do.
ne monument		46	33.00		47	59.00	do	Rept. '83.
d, light-house		32	16.18		45	20.78	do	Rept. '87.
		21	10.27		47	44.97	do	Do.
o.'s flag pole		20	48.55		47	30.42	do	Do.
house		22	47.18		47	42.78	do	Do.
dist Episcopal church tower		20	58.52		47	53.64	do	Do.
's brickyard chimney		21	42.02		48	12.84	do	Do.
tant Episcopal church		21	11.10		48	13.18	do	Do.
n Catholic church, cross		20	57.97		47	45.52	do	Do.
ad station chimney		21	15.50		47	00.79	do	Do.
ned church		20	54.78		47	51.29	do	Do.
Village Reformed church		21	43.17		49	18.51	do	Do.
		22	00.92		47	39.04	do	Do.
		36	50.21		45	21.68	do	Do.
Hook (bolt)		35	42.63		45	50.65	do	Do.
		16	25.71		46	49.53	do	Do.
e, Methodist Episcopal pire.		44	34.00		58	55.00	do	Rept. '83.
ormed church, 1 mile north r Corner.		38	42.00		48	20.00	do	Do.
y, St. John's Roman Catho- h.		38	26.12		44	20.90	do	Rept. '87.
nbush:								
Reformed church		35	18.42		42	00.69	do	Do.
dist Episcopal church		35	16.17		41	57.35	do	Do.
		40	35.51		45	13.30	do	Do.
n, Dutch Reformed church		34	35.00		52	53.00	do	Rept. '83.
Island, light-house		27	48.75		46	55.24	do	Rept. '87.
		40	07.68		43	12.61	do	Do.
oint		20	40.13		46	52.15	do	Do.
Point		18	21.96		47	01.83	do	Do.
ouse		18	21.91		47	01.49	do	Do.
d		16	36.77		47	51.94	do	Do.
		46	35.27		47	12.17	do	Do.
		35	55.66		43	56.92	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	′	″	°	′	″		
Greenbush:								
Presbyterian church	42	38	10.70	73	44	56.76	S. S	Rept. '87.
Ferry		38	30.21		45	03.56	do	Do.
Greenport, Reformed church		11	56.18		48	12.89	do	Do.
Guilderland		42	02.29		58	01.51	do	Do.
Church spire		42	14.00		58	10.00	do	Rept. '83.
Lutheran church spire		42	15.24		58	09.74	do	Rept. '87.
Hallenbeck		35	56.18		40	08.38	C. & G. S	Do.
South		16	19.20		49	58.70	S. S	Do.
Hamiltonville:								
Methodist Episcopal church spire		42	16.00		54	43.00	do	Rept. '83.
Three point (no station mark)		42	29.17		55	12.76	do	Rept. '87.
Hotailing Island		26	55.95		46	55.92	do	Do.
Home Lawn flag pole		43	41.00		45	36.00	do	Rept. '83.
Hudson (bolt)		15	22.54		47	51.34	do	Rept. '87.
Baptist church		15	05.93		47	27.95	do	Do.
Light-house		15	07.29		48	33.01	do	Do.
Lutheran church		14	55.30		47	03.34	do	Do.
Presbyterian church		15	04.27		47	21.98	do	Do.
Protestant Episcopal church		15	00.24		47	22.53	do	Do.
Roman Catholic church		15	05.09		47	38.86	do	Do.
Universalist church		15	00.31		47	14.32	do	Do.
Waterworks chimney		15	19.54		47	54.66	do	Do.
Iron works		42	23.39		41	47.03	do	Do.
Judson		19	47.63		46	03.76	do	Do.
Judson, barn cupola		19	44.00		46	01.00	do	Rept. '83.
Junction		19	48.24		46	26.15	do	Rept. '87.
Kinderhook, Reformed church		23	36.71		42	04.58	do	Do.
Knickerbocker, house cupola		27	40.55		46	11.99	do	Do.
Lampman		20	28.32		47	43.68	do	Do.
Lansing		44	12.82		42	58.58	do	Do.
Lansing Pine		45	38.73		50	37.75	do	Do.
Lisha's Kill, Dutch Reformed church		45	21.91		52	35.76	do	Do.
Lower Schodack Island		27	42.16		46	33.69	do	Do.
Merino, Columbia County		14	05.06		49	03.54	do	Bull. 122
Merwin		21	23.61		41	23.01	do	Do.
Milham (Levi), house cupola		23	49.92		43	28.08	do	Rept. '87.
Moles		37	43.18		45	02.77	do	Do.
Monument 20		45	26.61		57	49.07	do	Do.
Monument 97		46	28.07		49	24.17	do	Do.
Monument 192		40	47.28		43	23.57	do	Do.
Morrison		15	14.35		49	39.93	do	Do.
Mount Merino		14	05.06		49	03.53	do	Do.
Mount Olympus		44	40.24		41	01.67	do	Do.
Mull		29	55.00		47	04.07	do	Do.
Mull Island		28	26.46		47	04.62	do	Do.
Mull Plaat		29	18.09		47	00.39	do	Do.
Muller		34	16.31		44	59.99	do	Do.
New Baltimore:								
Baptist church		26	46.49		47	24.54	do	Do.
Dike light-house		27	08.99		46	34.80	do	Do.
Dutch Reformed church		26	44.71		47	20.78	do	Do.
Light-house		27	04.42		47	02.69	do	Do.
Methodist Episcopal church		26	53.94		47	17.69	do	Do.
Riverside House, summer-house flag pole.		26	44.09		47	13.22	do	Do.
Shipyard, chimney of		26	39.43		47	12.88	do	Do.
New Salem, Dutch Reformed church		37	25.10		57	58.31	do	Do.
New Scotland, Presbyterian church tower.		37	53.91		54	24.41	do	Do.
Nine-mile Tree, light-house		31	05.22		45	53.64	do	Do.
Niskayuna		46	00.32		49	57.62	do	Do.
Nutter Hook		21	25.86		47	20.25	do	Do.
Olcott's house, cupola		37	53.02		43	13.11	do	Do.
Orchard		27	37.68		47	34.84	do	Do.
Paarda Hook		33	18.15		45	25.57	do	Do.
Papscanee Island		35	54.87		45	29.46	do	Do.
Parke		35	59.85		46	04.96	do	Do.
Parsons		27	09.59		47	31.39	do	Do.
Patten		15	27.72		47	10.01	do	Do.
Patterson		36	13.07		45	49.75	do	Do.
South chimney of house		36	09.08		46	26.86	do	Do.
Powell		23	20.60		51	50.69	C. & G. S	Bull. 122
Railroad farm		17	37.63		47	50.96	S. S	Rept. '87.
Railway		41	11.94		42	38.32	do	Do.
Race course		41	17.34		42	54.99	do	Do.
Rafinesque		47	21.15		36	58.82	C. & G. S	Rept. '85.
Rexford Flats		51	23.23		53	50.53	S. S	Do.
Riley		41	42.83		42	08.15	do	Do.
Roha Hook		29	06.10		47	23.72	do	Do.
Light-house		28	50.87		47	19.54	do	Rept. '87.
Rotterdam, Methodist Episcopal church.		46	47.49		57	29.91	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	′	″	°	′	″		
Top	42	05	14.39	73	52	23.68	C. & G. S	
'emetery, Williams monument		41	54.00		44	15.20	S. S	Rept. '87.
rph		37	36.71		43	10.93	do	Do.
		40	02.18		44	04.83	do	Do.
ierhorn Island		31	20.19		45	59.55	do	Do.
'tady:								
nory, flag pole		48	36.81		56	18.97	do	Do.
tist church spire		48	56.80		56	23.58	do	Do.
t Dutch Reformed church ire.		49	00.93		56	51.27	do	Do.
t Presbyterian church spire		49	02.78		56	42.69	do	Do.
man Methodist Episcopal urch spire.		48	56.74		56	12.16	do	Do.
eorge's Protestant Episcopal urch spire.		49	05.68		56	42.84	do	Do.
ohn's Roman Catholic church re.		48	51.34		56	30.20	do	Do.
ohn's German Roman Catho- church spire.		48	40.28		56	25.57	do	Do.
nd Reformed church spire		48	53.28		56	23.44	do	Do.
Street Methodist Episcopal rch spire.		48	42.34		56	21.95	do	Do.
n College dome		49	02.35		55	49.33	do	Do.
n School		49	01.08		56	32.88	do	Do.
k. channel light-house		29	51.94		46	41.66	do	Do.
k Island		30	27.07		46	21.22	do	Do.
k Landing:								
h Reformed church		28	49.88		46	13.01	do	Do.
kerbocker ice house, flag pole		28	24.79		46	25.96	do	Do.
use cupola, near Mull		30	24.00		47	17.00	do	Rept. '83.
		42	20.88		42	30.58	do	Rept. '87.
st church spire		49	34.41		57	48.64	do	Do.
Reformed church tower		49	40.15		57	37.06	do	Do.
		40	30.60		39	46.50	do	Do.
nd		30	53.72		46	22.65	do	Do.
		17	34.43		46	05.05	do	Do.
		22	57.58		46	58.63	do	Do.
nd		37	35.41		51	58.26	do	Do.
dist Episcopal church spire		37	50.52		51	38.49	do	Do.
		19	20.65		47	13.84	do	Do.
		18	01.69		46	11.77	do	Do.
y station, chimney		18	37.36		46	20.63	do	Do.
se		25	25.27		47	11.51	do	Do.
t		23	21.83		46	00.01	do	Do.
house		24	41.02		46	43.04	do	Do.
ran church		23	24.43		46	23.82	do	Do.
ned church tower		23	16.70		46	55.86	do	Do.
		36	26.33		44	05.71	do	Do.
		28	48.11		45	49.84	do	Do.
		23	01.75		47	58.36	do	Do.
		24	55.23		46	29.83	do	Do.
		25	25.26		44	31.71	do	Do.
		30	14.70		45	39.55	C. & G. S	
Roman Catholic church		43	21.57		41	37.25	S. S	Do.
ary's Roman Catholic h.		43	28.86		41	30.99	do	Do.
Presbyterian church		44	31.07		41	04.93	do	Do.
resbyterian church		43	25.19		41	37.86	do	Do.
n's convent		42	56.64		41	29.80	do	Do.
n's Protestant Episcopal h.		43	32.21		41	39.63	do	Do.
ph's Provincial Seminary, west spire.		43	45.89		40	59.03	do	Do.
hael's Roman Catholic h.		42	04.67		41	48.72	de	Do.
l's Protestant Episcopal h.		43	45.61		41	27.17	do	Do.
r's church, Roman Catho-		44	16.84		41	07.76	do	Do.
reet Methodist Episcopal 1.		43	58.55		41	16.82	do	Do.
himney near east end of lam.		44	47.11		41	05.53	do	Do
metery, Wool's monu-		45	40.34		40	12.75	do	Do.
ity, northwest spire		42	43.00		41	00.00	do	Rept. '83.
Dutch Reformed church		36	02.00		53	28.00	do	Do.
Hook		01	24.50		50	40.45	C. & G. S	

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	′	″	°	′	″		
Van Alstyne	42	25	53.77	73	46	18.65	S. S	Rept. '87.
Van Buren		23	17.97		43	38.84	do	Do.
Van Dalfson		23	01.48		47	31.77	do	Do.
Van Denburg		33	10.08		44	09.71	do	Do.
Vanderpoel		26	28.43		47	16.62	do	Do.
Vanderzer		32	33.12		46	24.18	do	Do.
Van Rensselaer (C. S.)		39	02.10		43	38.10	do	Do.
Van Slyke		23	47.92		47	54.72	do	Do.
Van Wie		34	54.98		45	22.71	do	Do
Van Wie, stone light		85	05.70		45	29.59	do	Do.
Vineyard		20	13.56		47	21.03	do	Do.
Visehee Ferry, church spire		47	47.17		49	35.63	do	Do.
Vrooman		30	42.92		46	53.36	do	Do.
West Albany		40	38.00		46	30.00	do	Rept. '83.
West Ghent, Dutch Reformed church		17	33.81		43	03.60	do	Rept. '87.
West Troy:								
Baptist church		43	41.89		42	11.79	do	Do.
Dutch Reformed church		42	48.83		42	33.95	do	Do.
First Dutch Reformed church		43	33.88		42	05.80	do	Do.
St. Bridget Roman Catholic church.		42	53.48		42	27.60	do	Do.
Westertoe Island		37	20.13		45	40.82	do	Do.
Whannel		27	02.56		46	00.26	do	Do.
Whitehead's barn, west gable		21	31.47		46	45.66	do	Do.
Winnie's Dock		33	53.94		45	16.96	do	Do.
Winnie's Point		33	17.00		45	26.00	do	Rept. '83.
Wiswall		14	49.00		48	53.57	do	Rept. '87.
Wood		21	54.72		46	53.82	do	Do.
Yellow Pine		29	28.72		40	27.90	C. & G. S	
	42°-43°			74°-75°				
Adebahr	42	52	26.92	74	10	42.01	S. S	Do.
Amsterdam:								
Academy		56	34.95		11	28.74	do	Do.
Roman Catholic church spire		56	06.68		11	17.15	do	Do.
Argusville		47	50.00		31	12.55	do	Do.
Auriesville, Dutch Reformed church		55	43.86		18	50.52	do	Do.
Babcock		37	46.70		15	59.91	do	Do.
Baracsourie		43	30.71		29	26.18	do	Do.
Barrow's (W. C.) house		47	53.15		20	47.80	do	Do.
Bell's (W. H.) house		47	30.60		19	48.22	do	Do.
Black		58	44.08		10	04.23	do	Do.
Bouck		37	42.41		18	51.26	do	Do.
Bramans Corner, Baptist church spire.		47	49.00		15	05.00	do	Do.
Brandmill		54	32.14		02	38.36	do	Do.
Bronk		56	53.52		05	35.02	do	Do.
Canajoharie:								
Dutch Reformed church		54	18.25		34	12.92	do	
German Lutheran church		54	14.99		34	10.55	do	Do.
Nellis House		54	22.22		84	20.74	do	Do.
Protestant Episcopal church		54	14.70		34	19.38	do	Do.
Chapman		47	19.44		13	18.47	do	Do.
Charleston Four Corners, church tower.		48	50.00		24	46.00	do	Rept. '83.
Cobleskill:								
Hotel Augusta		40	41.44		29	06.05	do	Rept. '87.
Lutheran church		40	43.06		28	57.07	do	Do.
Carlisle, Presbyterian church		45	23.66		26	44.79	do	Do.
Catskill		11	23.85		02	14.59	C. & G. S	Do.
Mountain House, southeast corner.		11	41.00		02	06.60	S. S	Do.
Conover		46	58.61		17	26.66	do	Do.
Currytown, Dutch Reformed church tower.		51	35.17		28	09.65	do	Do.
Dockstader		45	25.37		40	07.69	do	Do.
Dougal		53	08.97		07	21.63	do	Do.
Duanesburg, church tower		46	10.00		09	25.00	do	Rept. '83.
Dunn Hill		59	26.38		22	16.02	do	Do.
Dunnsville:								
Flag pole		44	23.00		01	03.00	do	Do.
Dutch Reformed church west of		45	07.00		02	44.00	do	Do.
East Hill, primary		46	53.00		42	16.00	do	Do.
East Township, Baptist church spire		42	13.00		05	42.00	do	Do.
Esperance:								
Methodist Episcopal church		45	39.44		15	29.08	do	Rept. '87.
Presbyterian church		45	44.40		15	39.79	do	Do.
Failing		55	29.50		33	21.54	do	Do.
Finkel		47	00.72		29	02.00	do	Do.
Fonda		57	23.23		22	19.15	do	Do.
Court-house dome		57	13.05		22	34.29	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			74°-75°				
	°	′	″	°	′	″		
Fort Plain:								
Clinton Liberal Institute	42	55	54.23	74	37	47.90	S. S	Rept. '87.
Dutch church spire		55	58.73		37	41.39	do	Do.
Methodist Episcopal church spire		55	56.57		37	31.81	do	Do.
Freys Bush, Methodist Episcopal church spire.		54	36.51		40	04.57	do	Do.
Fultonville, J. H. Starin's house cupola.		56	34.95		21	54.72	do	Do.
Glen		53	22.60		19	25.97	do	Do.
Dutch Reformed church spire		53	41.88		20	31.47	do	Do.
German Evangelical church tower		57	29.00		31	07.00	do	Rept. '83.
Hagaman Mills, church		58	27.00		09	01.33	do	Rept. '87.
Helderberg (C. S.)		37	39.07		00	38.47	do	Do.
High Peak		10	05.00		05	42.00	do	Rept. '83.
Holmes		37	36.10		30	49.79	do	Rept. '87.
Hunter		10	39.50		13	49.31	G. S	Bull. 122.
Kelsey		37	32.38		21	54.68	S. S	Rept. '87.
Knowersville		42	12.02		02	00.58	do	Do.
Lutheran church		42	11.87		02	01.64	do	Do.
Knox		59	08.45		05	47.39	do	Do.
Knoxville:								
Methodist Episcopal church spire		40	23.00		06	18.00	do	Rept. '83.
Lutheran church spire, 2 miles east of town.		40	38.00		04	45.00	do	Do.
Little Falls, Universalist church		02	34.00		51	27.00	do	Do.
Mann		41	04.98		19	05.23	do	Rept. '87.
Mannys Corners, church		56	50.56		08	42.36	do	Do.
Mapletown		49	48.60		33	14.08	do	Do.
Dutch Reformed church tower		50	20.75		33	33.26	do	Do.
Middleburg, Dutch Reformed church spire.		36	18.51		20	16.23	do	Do.
Methodist Episcopal church spire		35	48.97		19	58.73	do	Do.
Monument 46 (C. B.)		44	24.81		05	54.74	do	Do.
Monument 52 (C. B.)		43	00.11		14	29.35	do	Do.
Monument 53 (C. B.)		49	48.96		13	14.96	do	Do.
Monument 74 (C. B.)		45	04.97		00	23.71	do	Do.
Nellis		58	46.00		37	15.55	do	Do.
Oak Ridge		47	28.11		19	19.98	do	Do.
Wasson C. Barlow's house		47	52.00		20	49.00	do	Rept. '83.
Old Palatine, church spire		58	08.63		37	42.88	do	Rept. '87.
Ostego (C. S.)		46	54.73		42	14.60	do	Do.
Ostrander		57	25.44		48	26.10	do	Do.
Overlook Mountain		05	05.00		05	33.00	do	Rept. '83.
Paine Hollow, Methodist Episcopal church.		57	39.35		54	14.06	do	Rept. '87.
Palatine, German Evangelical church tower.		57	29.95		31	05.90	do	Do.
Pisgah		22	39.18		14	43.27	G. S	Bull. 122.
Princetown		50	46.53		05	47.28	S. S	
Presbyterian church spire		48	25.00		04	47.00	do	Rept. '83.
Reaman		53	47.42		35	45.40	do	Rept. '87.
Richfield Springs, observatory		50	33.15		56	58.57	do	Do.
Richmondville, hotel flag pole		38	02.00		33	53.00	do	Rept. '83.
Rickard		58	21.29		31	28.21	do	Rept. '87.
Riders Corners, church tower		58	43.44		38	44.57	do	Do.
Romeyn		54	42.12		05	11.75	do	Do.
Rundell		27	15.27		03	04.84	G. S	Bull. 122.
Saltman's (Ezra L) house, cupola		57	14.73		33	15.26	S. S	Rept. '87.
St. Johnsville:								
Methodist Episcopal church spire		59	57.39		40	44.48	do	Do.
Union church tower		59	57.01		40	50.16	do	Do.
Schoharie:								
Cemetery, Williams monument		39	47.22		18	34.85	do	Do.
Lutheran church spire		39	53.01		18	40.21	do	Do.
Old Fort flag pole		40	38.64		18	08.02	do	Do.
Schuyler		58	54.72		26	35.71	do	Do.
Scotch Union, Presbyterian church spire.		52	18.87		08	09.16	do	Do.
Sears		43	44.08		14	43.81	do	Do.
Sharon Springs Hotel, window in gable.		47	52.00		36	49.00	do	Rept. '83.
Shoemaker		59	39.86		54	25.79	do	Do.
Sittle Hill		44	06.07		02	09.33	do	Rept. '87.
Sloansville, Baptist church tower		45	26.19		19	51.30	do	Do.
Stirling		48	42.42		33	26.66	do	Do.
Stone Arabia:								
Dutch Reformed church cupola		56	34.07		33	23.93	do	Do.
Lutheran church tower		56	25.80		33	22.38	do	Do.
Summit		35	42.94		34	58.73	do	Do.
Thompson		39	23.19		32	10.97	do	Do.
Tilpaugh		46	19.82		27	31.39	do	Do.
Tribes Hill, Presbyterian church tower.		57	17.89		17	01.94	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			74°-75°				
	°	′	″	°	′	″		
Turk	42	39	57.92	74	28	08.27	S. S	Rept. '87.
Utsayantho		23	56.21		35	24.12	do	Do.
Van Apse (Abram) barn, cupola		56	24.59		23	34.70	do	Do.
Van Atten		54	18.07		00	15.60	do	Do.
Van Deusen		56	58.10		28	00.29	do	Do.
Vly		14	45.50		26	29.60	G. S	Bull. 122.
Watersheet		51	49.16		04	13.98	S. S	
West Amsterdam, Lutheran church tower.		58	44.26		16	55.77	do	Rept. '87.
Willet		58	32.84		41	29.42	do	Do.
Windham, High Peak		18	53.78		08	36.22	G. S	Bull. 122.
Winne		43	49.55		02	32.48	S. S	Rept. '87.
Yule		56	40.67		53	58.48	do	Do.
	42°-43°			75°-76°				
Babell	42	16	26.13	75	40	51.85	do	Do.
Fenner		57	23.96		44	35.93	do	Do.
Getman		59	19.60		01	43.73	do	Do.
Maine		13	15.85		58	44.80	do	Do.
Solon		37	42.04		59	10.38	do	Do.
Tassel		56	29.13		19	00.47	do	Do.
Windsor		06	10.26		44	47.29	do	Do.
	42°-43°			76°-77°				
Alpine, Methodist Episcopal church	42	18	42.22	76	43	29.08	do	Do.
Ashland		01	54.62		47	01.88	do	Do.
Auburn, court-house dome		55	47.86		34	09.19	do	Do.
Barton		06	48.66		27	29.52	do	Do.
Brown		23	48.31		51	03.44	do	Do.
Burdett:								
Methodist Episcopal church		25	13.81		50	46.94	do	Do.
Presbyterian church		25	00.81		50	50.11	do	Do.
Cafferty		06	30.34		08	03.58	do	Do.
Catharine, Methodist Episcopal church.		18	46.23		46	58.58	do	Do.
Chemung		02	31.64		33	21.02	do	Do.
Clapp		58	11.87		02	19.08	do	Do.
Cortland:								
Baptist church		36	01.32		10	40.69	do	Do.
Normal School, east cupola		35	56.90		10	36.02	do	Do.
Wagon Company's chimney		35	58.38		10	15.94	do	Do.
Couch		17	56.13		48	32.43	do	Do.
Dryden		23	06.00		20	02.00	do	Rept. '83.
Do		28	07.19		20	01.20	do	Rept. '87.
Eddytown, Presbyterian church		31	17.13		55	47.12	do	Do.
Ellis		38	47.65		12	52.41	do	Do.
Elmira:								
First Methodist Episcopal church		05	31.48		48	16.04	do	Do.
First Presbyterian church		05	28.28		48	16.59	do	Do.
Park Congregational church		05	21.45		48	32.97	do	Do.
Female College tower		05	54.21		48	50.68	do	Do.
Public School, No. 5		05	50.54		49	16.47	do	Do.
Richardson shoe factory clock tower.		05	19.32		48	21.18	do	Do.
St. Mary's Roman Catholic church.		04	36.50		48	22.30	do	Do.
St. Patrick's Roman Catholic church.		05	37.81		48	39.30	do	Do.
Trinity Protestant Episcopal church.		05	24.06		48	30.13	do	Do.
Enfield		27	15.48		35	59.22	do	Do.
Erin		10	16.22		37	48.81	do	Do.
Fabius		48	41.63		01	14.88	do	Do.
Giles		53	02.27		26	13.44	do	Do.
Green		59	18.78		01	49.23	do	Do.
Havana:								
Baptist church		20	41.81		50	50.33	do	Do.
Cook Academy		20	30.85		50	22.16	do	Do.
Court-house		20	44.41		50	59.66	do	Do.
Methodist Episcopal church		20	44.58		50	44.23	do	Do.
Presbyterian church		20	43.33		50	37.14	do	Do.
Protestant Episcopal church		20	40.15		50	59.02	do	Do.
Union school-house		20	40.52		50	38.76	do	Do.
Hawley		06	22.99		52	15.73	do	Do.
Hector		26	47.09		48	21.04	do	Do.
Homer:								
Academy cupola		38	08.81		10	48.00	do	Do.
Baptist church		38	04.20		10	48.76	do	Do.
Methodist Episcopal church		38	05.57		10	48.50	do	Do.
Presbyterian church		38	07.38		10	48.18	do	Do.
Hornby		15	42.78		59	38.72	do	Do.
Horseheads		09	59.05		49	32.14	do	Do.

NEW YORK—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	76°-77°		
Horseheads—Continued.	° ′ ″	° ′ ″		
Baptist church	42 09 55.79	76 49 20.03	S. S.	Rept. '87
Methodist Episcopal church	09 58.97	49 20.31	do	Do.
Presbyterian church	09 57.77	49 19.98	do	Do.
Protestant Episcopal church	09 53.23	49 10.50	do	Do.
Howlett	59 52.95	17 26.55	do	Do.
Hoxsie	55 46.15	22 28.30	do	Do.
Hubert	36 42.74	08 40.05	do	Do.
Hungerford	25 45.22	27 03.45	do	Do.
Ithaca:				
Cornell University, barn cupola	26 58.12	28 45.87	do	Do.
McGraw Building	26 57.97	29 08.80	do	Do.
Sage Chapel	26 49.70	29 05.08	do	Do.
Sage College	26 45.24	29 02.06	do	Do.
Light-house dome	27 44.92	30 52.70	do	Do.
McGraw Fiske, house	27 03.28	29 18.29	do	Do.
Presbyterian church	26 32.12	29 56.93	do	Do.
Protestant Episcopal church	26 28.27	29 58.42	do	Do.
Roman Catholic church	26 24.64	30 03.15	do	Do.
Sprague fire-engine house, flag pole.	26 22.04	30 36.68	do	Do.
State Street Methodist Episcopal church.	26 22.57	30 07.79	do	Do.
Jacksonville, Methodist Episcopal church.	30 44.74	36 06.62	do	Do.
Kile	04 34.65	15 41.46	do	Do.
Maby	07 32.60	47 38.02	do	Do.
Mathews	07 30.65	50 34.80	do	Do.
Mitchel	56 35.05	31 46.27	do	Do.
Morehead	32 22.71	13 27.39	do	Do.
Moreland, Presbyterian church	18 28.25	54 34.67	do	Do.
Newfield	23 11.24	40 10.62	do	Do.
Niles	47 56.73	26 03.55	do	Do.
North Barton church	07 07.00	29 39.00	do	Rept. '83.
Oak Hill, Baptist church	05 21.90	27 07.62	do	Rept. '87.
Odessa:				
Free Will Baptist church	20 06.85	47 25.02	do	Do.
Wesleyan Methodist church	20 06.81	47 24.89	do	Do.
Orange	19 11.29	58 27.15	do	Do.
Ovid	40 43.43	49 18.22	do	Do.
Owego, court-house	42 06.08	15 47.00	do	Rept. '83.
Pompey Hill:				
Presbyterian church	53 58.97	00 57.34	do	Rept. '87.
Roman Catholic church	54 03.52	00 48.18	do	Do.
Reading Center:				
Baptist church	25 49.60	56 00.75	do	Do.
Methodist Episcopal church	25 51.36	56 00.99	do	Do.
Richford	23 47.15	13 20.84	do	Do.
Ripley	47 24.85	14 26.42	do	Do.
Rock Stream, church	28 19.94	55 45.06	do	Do.
Ross Hill, church	05 08.00	25 30.00	do	Rept. '83.
Seeley	58 33.42	22 11.68	do	Rept. '87.
Shafford, church	48 15.00	15 56.00	do	Rept. '83.
South Hill	25 49.04	29 45.28	do	Rept. '87.
Strader	21 41.50	52 03.36	do	Do.
Sugar Hill, Presbyterian church	21 45.13	59 26.03	do	Do.
Trumansburg:				
Baptist church	32 34.84	39 43.53	do	Do.
Methodist Episcopal church	32 26.06	39 30.10	do	Do.
Presbyterian church	32 28.63	39 33.00	do	Do.
Protestant Episcopal church	32 27.01	39 40.02	do	Do.
Turner	25 07.71	29 38.70	do	Do.
University	26 54.15	29 08.73	do	Do.
Van Dorns Corners, Methodist Episcopal church.	26 53.92	34 29.77	do	Do.
Virgil	29 34.06	08 24.95	do	Do.
Watkins:				
Academy	22 37.80	52 09.33	do	Do.
Court-house	22 36.50	52 16.49	do	Do.
Lake View Hotel	22 42.38	52 39.24	do	Do.
Methodist Episcopal church	22 50.90	52 20.53	do	Do.
Palmater's (O.) house	23 59.99	51 08.21	do	Do.
Presbyterian church	22 48.03	52 15.43	do	Do.
Protestant Episcopal church	22 47.89	52 16.56	do	Do.
Roman Catholic church	22 30.56	52 12.21	do	Do.
Watkins Glen observatory	22 33.40	52 29.73	do	Do.
West Dryden, church	31 02.21	24 54.07	do	Do.
White	08 30.17	29 18.65	do	Do.
	42°-43°	77°-78°		
Bristol	42 42 00.62	77 24 31.05	do	Do.
Gorham	48 54.11	10 54.82	do	Do.
Milo	35 16.32	01 46.62	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			77°-78°				
	°	′	″	°	′	″		
Scottsville	42	59	59.29	77	42	37.59	L. S.	Final Rept.
Sproul		23	13.77		00	10.51	S. S.	Rept. '87.
Swale		12	16.23		29	28.02	do	Do.
Urbana		25	40.54		15	14.99	do	Do.
Worden		44	46.66		25	34.22	do	Do.
	42°-43°			78°-79°				
Batavia:								
Court-house dome	42	59	51.75	78	11	13.19	do	Do.
German Methodist Episcopal church spire.		59	45.29		10	56.40	do	Do.
Johnston Harvester Works, chimney.		59	38.28		10	25.84	do	Do.
Methodist Episcopal church spire		59	50.66		10	53.59	do	Do.
Presbyterian church tower		59	47.98		10	45.62	do	Do.
Buffalo		53	03.18		52	41.83	L. S	Final Rept.
Buffalo Plains		56	58.22		49	03.79	do	Do.
East base		59	19.57		48	32.98	do	Do.
Erie County:								
Buffalo light-house		52	40.10		53	24.00	do	Do.
Horseshoe light-house		52	52.50		54	56.20	do	Do.
Intersection of Michigan and Exchange streets, Buffalo.		52	41.10		52	14.30	do	Do.
Hamburg		46	50.61		51	31.92	do	Do.
Norris		59	23.95		08	56.96	S. S	Rept. '87.
Richmond		35	16.65		52	37.69	G. S	Bull. 122.
West Base		57	20.56		52	44.54	L. S	Final Rept.
	42°-43°			79°-80°				
Barcelona	42	20	32.00	79	35	24.40	do	Do.
Brocton		24	07.00		28	41.80	do	Do.
Dunkirk:								
Chimney of Brook's Locomotive Works.		29	06.40		19	26.80	do	Do.
Light-house		29	37.80		21	15.80	do	Do.
New light-house		29	44.30		21	25.80	do	Do.
Dean		32	33.61		09	15.62	G. S	Bull. 122.
Deering		25	49.50		14	19.08	do	Do.
Pierce		26	06.00		09	18.82	do	Do.
Prospect		19	29.50		29	59.60	L. S	Final Rept.
Sheflin		36	38.41		00	30.72	G. S	Bull. 122.
Silver Creek		31	13.94		13	27.81	L. S	Final Rept.
Sturgeon Point		41	24.88		02	53.93	do	Do.
Westfield		16	25.30		37	30.71	do	Do.
High School		19	29.70		34	23.20	do	Do.
Methodist Episcopal church		19	26.50		34	33.20	do	Do.
	41°-42°			71°-72°				
Chocomount	41	16	48.06	71	57	48.05	C. & G. S	Do.
Montauk		03	54.39		54	18.43	do	
Montauk, 2		03	54.38		54	18.50	do	Rept. '85.
	41°-42°			72°-73°				
Brown Hill	41	09	11.29	72	17	36.46	do	Do.
Great Gull Island		12	06.43		07	06.21	do	Do.
Horton Point		04	58.21		26	53.61	do	Do.
Mattituck Hills		00	08.46		34	29.75	do	Do.
Mount Prospect		15	21.51		00	35.93	do	Do.
Mount Prospect, 2		15	21.54		00	35.87	do	Do.
Shelter Island		04	38.99		21	39.79	do	Do.
	41°-42°			73°-74°				
Bailey	41	18	43.79	73	33	06.07	do	Do.
Bald Hill		30	05.88		55	03.94	do	Do.
Bancroft		33	41.11		31	42.69	do	Do.
Barnes		48	14.31		51	00.74	do	
Bingham		35	31.24		59	31.60	do	
Boice		55	54.81		49	31.30	G. S	Bull. 122.
Brace Mountain, monument		02	39.91		29	34.88	C. & G. S	
Briggs		34	35.88		31	49.10	do	
Bussing		09	36.33		40	47.58	do	
Buttermilk		06	36.44		48	38.90	do	
Chapel Light		43	08.30		31	07.20	do	
Clark monument		48	02.69		30	27.96	do	
Clove		41	18.57		41	36.06	do	
Corner Stone		02	58.38		29	15.96	do	
Dickerson		15	32.13		52	02.38	do	
East Bluff		56	21.21		28	18.02	do	
Fields West		02	17.38		43	34.48	do	
Golden Ridge		38	44.88		59	08.31	do	
Haines		54	37.74		34	08.07	do	
Hamlin		59	10.51		32	48.90	do	
High Tor		11	15.51		57	56.65	do	
Hook Mountain		07	27.34		54	43.15	do	
Hussey Hill		53	08.54		59	40.69	G. S	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
Iron bolt, near 30 mile boundary stone	41	43	08.36	73	30	51.65	C. & G. S	
Kingston City Hall		55	37.46		59	47.90	G. S	Bull. 122.
Lewisboro, Presbyterian church (1865).		16	24.03		33	17.57	C. & G. S	
Lloyd		49	17.24		53	14.19	do	Do.
Merwin		14	09.09		19	57.60	do	
Monument stone		34	24.64		31	35.87	do	
Osborne		35	16.90		32	29.32	do	
Plymouth		46	25.41		37	17.28	do	
Port Chester		00	09.16		40	22.77	do	
Poughkeepsie		41	18.00		53	24.00	do	
Preston		42	36.70		31	04.87	do	
Prospect		52	27.96		57	49.92	do	Do.
Purdy		03	10.12		41	36.08	do	
Ridgefield Angle, monument stone		17	42.68		33	06.79	do	
Round Mountain		25	06.37		32	25.65	do	
Monument		25	11.91		32	20.53	do	
Sandford		01	13.46		39	56.96	do	
Spencers Corner, spire (1863)		57	45.62		30	08.69	do	
Stewart		46	13.66		58	09.96	do	
Stratford Shoal (Middle Ground) light-house (1881-1885).		03	35.78		06	06.11	do	
Terry		56	22.29		58	19.53	do	Do.
Traver		55	05.04		52	41.44	do	
Underhill		35	47.39		51	56.70	do	
Vervalin		41	21.52		50	54.79	do	
Warner		24	04.88		56	33.99	do	
Watermelon		21	53.81		43	16.37	do	
Wilton monument		12	46.07		28	56.40	do	
Wing monument stone		33	30.38		31	40.71	do	
	41°-42°			74°-75°				
Pink	41	54	04.50	74	02	46.89	G. S	
Prospect Hill		33	21.83		01	48.68	C. & G. S	
Schuyler		58	54.73		26	35.72	S. S.	
Sky Top Tower		45	49.76		09	23.64	G. S	Do.
Slide		59	56.97		23	10.94	do	Do.

NEW JERSEY.

	41°-42°			74°-75°				
	°	′	″	°	′	″		
Allendale church spire	41	01	49.56	74	07	34.74	C. & G. S	Final Rept., Vol. 1.
Bald Mountain		07	14.54		12	02.91	do	Do.
Beach Mountain		10	00.16		17	40.09	do	Do.
Bear Fort		08	26.15		23	31.50	do	Do.
Beaver Run		09	21.00		38	46.77	do	Do.
Catfish Pond, summit, east of pond		01	57.42		59	50.19	do	Do.
Centerville		12	54.07		50	29.59	do	Do.
Culver Gap		10	20.99		47	42.03	do	Do.
Darlington		04	42.70		12	32.80	do	Do.
Decker Pond		12	14.34		32	02.25	do	Do.
Deckertown, Presbyterian church spire.		12	39.10		36	23.47	do	Do.
Dunker Pond		04	58.50		28	57.03	do	Do.
East and west Jersey line (on Blue Mountain).		08	46.65		50	59.68	do	Do.
Franklin furnace stack		06	32.22		35	21.34	do	Do.
Glenwood		15	27.31		30	17.51	do	Do.
Hamburg		08	53.35		31	49.78	do	Do.
High Point		19	15.24		39	42.98	do	Do.
High Torne		09	05.39		00	47.33	do	Do.
Lafayette		07	53.51		41	26.76	do	Do.
Macopin		02	56.21		24	03.59	do	Do.
Newton, Presbyterian church spire		03	27.30		45	18.60	do	Do.
Ramsey, church tower		03	33.61		08	32.10	do	Do.
Smith Hill		04	57.55		44	49.77	do	Do.
Sparta		00	58.46		38	15.64	do	Do.
Waykoff, church cupola		00	27.73		10	25.98	do	Do.
Woodport		00	40.05		35	29.96	do	Do.
	40°-41°			73°-74°				
Cherry Hill	40	54	45.91	73	58	12.17	do	Do.
Coytesville		51	37.59		58	45.27	do	Do.
Duer		59	53.46		54	10.37	do	Do.
Englewood		53	28.16		58	16.05	do	Do.
Fort Lee, flagstaff		50	49.00		57	53.76	do	Do.
Navesink		23	47.86		59	09.67	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			73°-74°				
	°	'	"	°	'	"		
Navesink	40	23	18.14	73	59	13.40	C. & G. S	Final Rept., Vol. 1.
Lighthouse		23	45.23		59	08.52	do	Do.
Palisade		59	52.93		54	17.49	do	Do.
Schraalenburg, church spire		56	25.10		59	40.05	do	Do.
State line, stone on bank of Hudson River.		54	50.10		55	28.95	do	Do.
	40°-41°			74°-75°				
Allentown, Reformed church spire	40	10	27.10	74	35	14.00	do	Do.
Andover		59	09.80		44	49.40	do	Do.
Aquackanonck		51	03.73		07	45.60	do	Do.
Arney		00	28.66		42	12.62	do	Do.
Baird		14	09.85		24	51.16	do	Do.
Bald Hill		57	39.81		21	08.61	do	Do.
Banta		53	12.54		00	59.46	do	Do.
Bay Way, Staten Chemical Co.'s chimney.		37	56.00		12	15.30	do	Do.
Bayard		35	01.66		12	43.94	do	Do.
Beacon Hill		22	26.55		13	41.91	do	Do.
Bedminster, church cupola		40	14.70		38	43.00	do	Do.
Beers Hill		23	33.76		11	26.19	do	Do.
Bergen, Dutch Reformed church		43	37.14		04	04.35	do	Do.
Bergen Fields, church spire		55	45.64		00	13.18	do	Do.
Bergen Neck		45	52.00		02	36.50	do	Do.
Bergen Point, spire		38	52.17		07	39.14	do	Do.
Bird		39	05.83		10	28.39	do	Do.
Bishop's barn		03	47.40		41	38.00	do	Do.
Bloomfield		32	06.71		19	28.84	do	Do.
Boonton, Presbyterian church spire		54	23.52		24	37.38	do	Do.
Bordentown, flag pole		08	52.95		42	49.59	do	Do.
Bordentown, Presbyterian church spire.		08	36.50		42	37.10	do	Do.
Bordentown Observatory		09	20.57		42	43.74	do	Do.
Bordentown, church spire		08	48.70		42	50.10	do	Do.
Bound Brook		34	59.36		31	57.27	do	Do.
Boynton's Tile Works, near Woodbridge Landing.		32	26.58		15	21.56	do	Do.
Burdge		23	02.23		01	45.70	do	Do.
Burlington, St. Mary's spire		04	37.80		51	43.60	do	Do.
Bury		50	28.80		05	22.41	do	Do.
Caldwell, church spire		50	20.98		16	33.92	do	Do.
Caldwell		50	24.29		15	24.67	do	Do.
Do		50	24.10		15	24.70	do	Do.
Carhart		25	03.93		02	31.56	do	Do.
Caven Point		41	33.96		04	18.97	do	Do.
Centerville, church spire		40	05.83		06	53.16	do	Do.
Chapel Hill, back light		23	53.80		03	32.66	do	Do.
Chapel Hill, light-house pole		23	54.48		03	32.57	do	Do.
Cherryville, spire		33	44.70		54	15.50	do	Do.
Cherryville		33	45.15		54	31.01	do	Do.
Chestnaquack		27	40.13		15	03.39	do	Do.
Chestnaquack Point		27	39.58		15	02.36	do	Do.
Christopher		04	13.42		11	56.75	do	Do.
Claybanks		07	14.42		47	53.03	do	Do.
Cold Soil		20	40.64		42	33.50	do	Do.
Columbus, west spire		04	25.00		43	31.40	do	Do.
Compton		26	22.54		05	29.84	do	Do.
Conasconck Point		27	33.40		10	44.64	do	Do.
Conover		20	41.08		01	27.32	do	Do.
Conover beacon		25	17.01		03	21.29	do	Do.
Constable Point		39	26.12		05	45.51	do	Do.
Cornhill		22	23.78		54	42.70	do	Do.
Cranbury:								
First Presbyterian church steeple		18	26.38		31	08.32	do	Do.
Second Presbyterian church spire		18	50.40		30	51.60	do	Do.
Crane		50	08.02		13	08.76	do	Do.
Cranford, Presbyterian church spire		39	28.10		18	11.60	do	Do.
Crosswick, spire		09	16.30		39	02.10	do	Do.
Croton		29	04.12		54	45.55	do	Do.
Cushetunk		37	24.80		48	26.90	do	Do.
Danville		52	12.03		56	12.86	do	Do.
Dayton, church spire		22	32.80		30	43.70	do	Do.
Debow hill		10	58.17		25	36.79	do	Do.
Delanco		02	46.15		57	46.20	do	Do.
Delanco, church spire		02	58.11		57	25.15	do	Do.
Disboro Hill		14	48.23		27	26.00	do	Do.
Dunellen, spire		35	39.90		27	50.20	do	Do.
Dutch Neck, spire		16	57.50		36	50.30	do	Do.
East and west Jersey line		53	49.06		44	54.13	do	Do.
East Millstone, Reformed church cupola.		30	10.14		34	47.35	do	Do.
East Trenton, Rubber Works chimney		14	23.00		43	39.00	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			74°-75°				
	°	′	″	°	′	″		
Elizabeth:								
First Presbyterian church spire	40	39	45.60	74	12	56.80	C. & G. S	Final rept., Vol. 1.
St. Mary's church spire		39	29.90		13	07.80	do	Do.
Elizabethport Oil Cloth Co.'s chimney.		38	45.96		11	45.84	do	Do.
Elizabethport, spire Presbyterian church.		38	52.45		11	27.94	do	Do.
Elizabethtown, spire First Presbyterian church.		39	45.54		12	56.67	do	Do.
Ewing, church spire		16	14.40		48	02.50	do	Do.
Fairfield, spire Reformed church		53	04.54		16	58.03	do	Do.
Fleming		00	15.97		03	31.97	do	Do.
Flemington, spire Methodist church		30	20.23		51	30.22	do	Do.
Florence, foundry chimney		07	31.10		49	05.60	do	Do.
Fox Hill		43	59.01		48	19.05	do	Do.
Freehold, spire old court-house		15	37.18		16	28.40	do	Do.
Freehold, spire Reformed church		15	28.00		16	42.40	do	Do.
Garriell		20	34.44		03	05.72	do	Do.
Gibbet Island		41	58.32		02	25.39	do	Do.
Goat Hill		20	44.75		56	17.05	do	Do.
Grandon Hill		15	47.42		13	55.76	do	Do.
Green Island		00	35.22		06	26.49	do	Do.
Green Pond		58	33.64		32	01.63	do	Do.
Hackensack, church spire		53	18.55		02	32.65	do	Do.
Hackettstown		51	08.08		52	19.41	do	Do.
Hamilton Square, Baptist church		13	46.10		39	37.30	do	Do.
Hardwick, church cupola		59	44.10		51	39.00	do	Do.
Harrison House, cupola		02	22.67		59	47.93	do	Do.
Hawk		33	41.77		14	25.40	do	Do.
Do		02	35.95		58	39.21	do	Do.
Hazel's farm		18	05.57		40	28.29	do	Do.
High Mountain		58	14.12		11	55.38	do	Do.
Highwood		46	12.70		01	02.06	do	Do.
Highland of Squan		06	10.48		04	37.60	do	Do.
Hilton		25	19.99		03	29.34	do	Do.
Hope, church spire		54	31.90		58	11.70	do	Do.
Hunter House, north chimney		00	47.91		59	07.46	do	Do.
Jenny Jump Mountain		52	02.20		59	20.80	do	Do.
Jersey City:								
Spire		42	53.18		02	16.75	do	Do.
Flagstaff		42	55.03		02	17.10	do	Do.
Key East Hotel, flagstaff		11	29.60		00	37.80	do	Do.
Keyport, spire		26	15.21		12	07.14	do	Do.
Kill von Kull Oil Cloth Co.'s chimney.		39	18.82		06	33.44	do	Do.
Kills Light, Bergen Point		38	34.83		08	55.74	do	Do.
King		01	21.05		56	29.70	do	Do.
Kingsland		47	47.76		07	32.55	do	Do.
Lamington, church spire		39	38.20		43	12.20	do	Do.
Lawrenceville		18	07.81		44	08.31	do	Do.
Standpipe		17	31.90		44	10.90	do	Do.
Spire		17	53.80		43	44.85	do	Do.
Liberty pole, Long Branch village		17	58.35		00	12.20	do	Do.
Light-house flag		26	53.55		07	16.71	do	Do.
Linden, spire Episcopal church		37	39.70		15	07.00	do	Do.
Linden, spire Reformed church		38	02.60		15	32.20	do	Do.
Lippincott, hill		15	20.43		07	49.81	do	Do.
Mapleton		21	11.42		36	43.43	do	Do.
Matayan		26	51.67		12	38.80	do	Do.
Matayan Point		26	53.06		12	39.43	do	Do.
Mechanicsville, church spire		37	11.20		45	00.40	do	Do.
Menlo Park, tall iron stack		33	49.00		20	22.50	do	Do.
Metuchen, spire Presbyterian church		32	25.70		21	34.50	do	Do.
Middlebush, church spire		29	49.87		31	42.81	do	Do.
Midland Park, church tower		59	26.80		08	31.60	do	Do.
Mine Mount		43	19.05		36	20.28	do	Do.
Morgan		28	03.76		15	59.33	do	Do.
Do		28	10.75		15	56.15	do	Do.
Do		28	07.88		15	53.80	do	Do.
Morristown, spire Presbyterian church.		47	50.43		28	49.89	do	Do.
Mount Canoe		19	40.56		51	39.58	do	Do.
Mount Holly		00	09.12		47	19.30	do	Do.
Mount Horeb		36	42.07		34	16.27	do	Do.
Mount Mitchell, north edge of Highlands.		24	30.57		00	26.20	do	Do.
Mount Olive		52	02.48		42	52.50	do	Do.
Mount Rose		22	03.36		43	25.74	do	Do.
Netherwood		37	33.70		24	00.40	do	Do.
New Brunswick:								
Rutgers College cupola		29	55.43		26	48.12	do	Do.
Spire St. James		29	38.00		26	53.30	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	40°-41°			74°-75°				
	°	′	″	°	′	″		
New Dover, spire	40	35	07.20	74	20	26.40	C. & G. S	Final rept., Vol. 1.
Newark:								
Spire Methodist church		44	06.18		10	12.50	do	Do.
Spire First Presbyterian church		44	03.78		10	22.16	do	Do.
Spire Episcopal church		44	25.42		10	10.35	do	Do.
Bay light or Passaic light		41	46.29		07	39.13	do	Do.
Bay beacon		42	08.20		07	27.87	do	Do.
Neck		42	47.57		08	19.90	do	Do.
Newell		11	43.95		14	25.67	do	Do.
North Branch		35	55.35		40	53.28	do	Do.
Spire Reformed church		35	56.60		40	22.20	do	Do.
Ocean Beach, Colorado House		10	23.80		00	57.50	do	Do.
Ocean House, flagstaff		22	54.54		58	33.80	do	Do.
Palmerpaw		40	40.84		05	59.22	do	Do.
Paramus, church spire		59	07.12		05	33.28	do	Do.
Parsippany, church spire		51	52.70		24	24.20	do	Do.
Parsippany, spire Presbyterian church.		51	52.77		24	23.87	do	Do.
Passionist Fathers' Monastery, West Hoboken.		45	56.98		02	12.18	do	Do.
Pennington Seminary, cupola		19	38.16		47	37.90	do	Do
Perth Amboy, spire Episcopal church		30	13.34		15	56.15	do	Do.
Perth Amboy, Presbyterian church		30	20.79		15	57.80	do	Do.
Pickles		35	40.96		49	26.17	do	Do.
Pigeon Hill		24	27.90		04	43.23	do	Do.
Pleasant Corner, church spire		26	28.63		51	24.15	do	Do.
Pluckamin, church spire		38	52.60		38	32.50	do	Do.
Plum		01	56.99		59	26.61	do	Do.
Point Comfort		27	23.59		08	04.95	do	Do.
Polhemus		19	02.80		08	56.52	do	Do.
Poplar Ridge		22	17.10		42	30.35	do	Do.
Pottersville		42	24.80		44	06.10	do	Do.
Powder Mills, machine-shop chimney		55	30.11		16	33.39	do	Do.
Princeton College, cupola		20	54.86		39	34.86	do	Do.
Do		20	55.00		39	35.10	do	Do.
Princeton Seminary, cupola		20	42.80		39	53.86	do	Do.
Princeton water tower		20	23.50		40	03.50	do	Do.
Quakertown, spire		33	52.90		56	31.50	do	Do.
Rahway, spire First Presbyterian church.		36	31.80		16	34.10	do	Do.
Do		36	53.74		16	51.81	do	Do.
Do		36	53.80		16	51.80	do	Do.
Rancocas		02	36.10		58	40.44	do	Do.
Randolph		36	44.51		23	40.02	do	Do.
Raritan woolen mill chimney		33	54.72		37	57.02	do	Do.
Readington, spire Reformed church		34	05.16		44	09.19	do	Do.
Readington, church spire		34	05.20		44	09.20	do	Do.
Red Bog		14	06.08		03	14.06	do	Do.
Do		14	05.81		03	13.71	do	Do.
Robbins Reef light		39	26.45		03	56.68	do	Do.
Roselle, flagstaff		39	37.00		15	50.40	do	Do.
Rosemont, spire		25	39.40		59	26.40	do	Do.
Rowan		38	54.14		07	33.62	do	Do.
Sand Ridge, spire Baptist church		25	23.15		57	14.59	do	Do.
Sandhills		24	30.00		32	39.08	do	Do.
Sandy Hook		27	44.98		00	24.70	do	Do.
Signal		28	19.85		00	23.11	do	Do.
Light-house		27	42.29		00	06.46	do	Do.
Sawyer, Tufts Point		33	38.86		13	26.27	do	Do.
Sayre, hill		40	46.26		17	17.28	do	Do.
Schooley Mountain		49	47.53		47	33.15	do	Do.
Schuyler		46	48.88		08	30.07	do	Do.
Sea Girt, Beach House, north flagstaff		07	34.80		01	49.90	do	Do.
Seward		28	55.60		16	33.05	do	Do.
Hill		47	12.80		40	35.20	do	Do.
Sewaren		32	47.50		15	18.54	do	Do.
Sheep Hill		55	09.18		24	24.05	do	Do.
Shooter's Island		38	36.84		09	39.94	do	Do.
Chimney		38	32.58		09	39.70	do	Do.
Shotwell		82	48.13		15	21.06	do	Do.
Shrewsbury, spire		19	25.00		03	41.53	do	Do.
Springfield		41	22.14		21	25.14	do	Do.
Somerville, spire First Reformed church.		34	06.48		36	41.42	do	Do.
South Amboy, depot Pennsylvania R. R.		29	29.02		16	35.58	do	Do.
Do		28	47.31		17	19.98	do	Do.
Sourland		25	51.66		45	39.10	do	Do.
Standard Chemical Co., chimney		36	54.00		12	21.73	do	Do.
State Reform School, tower		20	35.60		23	55.60	do	Do.
Staten Chemical Co., chimney		37	55.90		12	15.47	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			74°-75°				
	°	′	″	°	′	″		
Stelton, church spire	40	31	01.50	74	24	26.00	C. & G. S.	Final Rept., Vol. 1.
Stevens		44	41.09		01	26.44	do	Do.
Do		44	41.14		01	26.44	do	Do.
Taylor Mount		02	03.60		33	01.90	do	Do.
Terhune		51	40.71		04	56.66	do	Do.
Three Bridges, church spire		31	23.23		47	49.49	do	Do.
Throckmorton		15	06.90		10	48.57	do	Do.
Tottenville		30	30.90		14	37.90	do	Do.
Tranquility, church spire		56	38.70		48	14.00	do	Do.
Trenton:								
Spire First Presbyterian church		13	13.13		45	49.18	do	Do.
Spire Roman Catholic church		12	51.50		45	40.60	do	Do.
Spire Methodist church		13	13.50		45	36.70	do	Do.
Spire Baptist church		12	41.40		45	36.40	do	Do.
Statehouse dome		13	13.80		46	13.10	do	Do.
Spire, State and Clinton streets		13	16.80		45	21.30	do	Do.
Van Kensen's house, 1 mile south of Newton.		32	16.40		28	06.20	do	Do.
Van Riper		53	36.64		08	24.14	do	Do.
Vanhorne		39	08.23		08	26.70	do	Do.
Vreeland		50	00.72		00	39.47	do	Do.
Wallace		44	33.01		11	15.99	do	Do.
Warrenville		53	53.00		50	21.60	do	Do.
Washington, old chimney, bank of canal.		45	55.60		59	17.20	do	Do.
Washington Hunter		00	55.51		59	08.33	do	Do.
Do		00	55.73		59	16.80	do	Do.
Washington Rock		36	45.70		28	20.90	do	Do.
Watnong		50	55.48		29	39.93	do	Do.
Wayne, chimney powder mill		55	30.10		16	33.50	do	Do.
Weasel		52	36.81		11	12.21	do	Do.
Westfield, spire Presbyterian church		39	14.10		20	52.70	do	Do.
White Hall		42	29.40		54	00.60	do	Do.
White Hill		08	22.49		43	53.26	do	Do.
White Horse		11	13.50		42	27.11	do	Do.
Williams		34	53.88		12	51.94	do	Do.
Wilson		26	21.67		05	28.82	do	Do.
Wilson Beacon		26	38.60		08	11.22	do	Do.
Windsor, spire		14	34.50		34	57.70	do	Do.
Woodbridge		33	25.21		14	40.83	do	Do.
Spire Presbyterian church		33	42.50		16	25.94	do	Do.
Landing		32	45.93		15	19.71	do	Do.
odside		03	47.52		49	34.03	do	Do.
ynant		32	57.98		14	18.59	do	Do.
Do		36	27.11		13	11.48	do	Do.
lis		32	45.72		16	37.64	do	Do.
	39°-40°			74°-75°				
secon	39	25	12.43	74	29	27.08	do	Do.
secon light-house		21	58.74		24	52.27	do	Do.
ple Pie Hill		48	26.62		35	23.83	do	Do.
co		46	17.70		53	08.20	do	Do.
sion Mill tower		44	21.50		43	30.60	do	Do.
cony		55	27.09		23	40.94	do	Do.
negat Inlet		45	58.47		06	15.43	do	Do.
rnegat light-house		45	51.61		06	23.78	do	Do.
rnegat, Methodist church spire		45	09.81		13	20.04	do	Do.
sley		17	02.53		37	00.20	do	Do.
sley Point		16	50.11		37	41.08	do	Do.
hin		48	55.85		54	45.07	do	Do.
ckman		15	07.94		39	33.53	do	Do.
ngie		28	44.36		41	16.71	do	Do.
dgeway, summit		46	34.43		19	33.26	do	Do.
gantine Beach		25	52.68		19	57.31	do	Do.
wn Mill Observatory		58	09.50		34	53.30	do	Do.
kingham		55	57.90		28	30.80	do	Do.
na Vista		30	50.60		55	29.70	do	Do.
e May, court-house spire		04	53.00		49	29.00	do	Do.
lisle		12	06.52		57	07.80	do	Do.
ar		13	34.08		38	12.08	do	Do.
ar Creek		51	47.44		08	12.94	do	Do.
ar Hummock		34	10.58		20	39.31	do	Do.
ton		12	01.01		39	21.35	do	Do.
mer		35	12.24		13	12.76	do	Do.
berry		56	40.21		04	18.55	do	Do.
e		03	03.25		49	48.51	do	Do.
s		04	31.75		44	20.80	do	Do.
ser Point		38	00.40		15	14.94	do	Do.
ble Creek		44	27.84		10	40.39	do	Do.
hty's tavern		26	53.96		51	46.60	do	Do.
Inlet		20	34.98		28	17.72	do	Do.
dge		06	06.63		47	36.46	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			74°-75°				
	°	′	″	°	′	″		
Elwood	39	34	40.33	74	42	55.55	C. & G. S.	Final Rept., Vol. 1.
English Creek		22	18.30		39	18.30	do	Do.
Estellville		22	21.40		45	44.10	do	Do.
Evesham, summit of Mount Laurel		56	03.45		53	40.41	do	Do.
Fish		18	39.50		32	34.28	do	Do.
Fishing Creek		01	07.28		56	51.86	do	Do.
Forked River		49	22.83		09	28.41	do	Do.
Four Mile		53	08.70		34	11.60	do	Do.
Gibbsboro		50	20.57		56	59.38	do	Do.
Good Luck Point		55	21.58		07	07.10	do	Do.
Goose Creek		57	07.97		06	40.38	do	Do.
Goshen		07	39.64		53	30.63	do	Do.
Gowdy's house, cupola		57	11.73		10	34.90	do	Do.
Great Swamp		40	42.53		08	59.32	do	Do.
Grore		20	03.74		30	17.18	do	Do.
Hammock		07	00.00		53	30.65	do	Do.
Hammonton		38	48.05		49	19.29	do	Do.
Heart		15	34.23		38	35.80	do	Do.
Hickey		37	37.20		11	23.36	do	Do.
Hickory Island		41	14.94		13	03.12	do	Do.
Holmes		07	35.91		46	13.33	do	Do.
Huckleberry		51	24.50		44	15.70	do	Do.
Island Beach		49	05.52		05	28.73	do	Do.
Isle		10	36.65		40	32.66	do	Do.
Jemima, Mount		43	43.00		27	04.10	do	Do.
Kellogg		26	00.50		59	09.80	do	Do.
Leaming Beach, north		06	29.26		42	32.14	do	Do.
Leaming Point		00	59.84		51	18.08	do	Do.
Leed Point		29	02.37		26	00.00	do	Do.
Leedsville		20	55.88		33	39.42	do	Do.
Do		20	56.52		33	40.28	do	Do.
Lewistown, windmill		59	26.90		37	11.70	do	Do.
Limerick		05	43.37		43	23.69	do	Do.
Linwood		20	54.06		33	38.76	do	Do.
Little Egg Harbor light		30	22.11		17	08.32	do	Do.
Long Beach		33	18.89		14	41.23	do	Do.
Ludlam Beach		08	44.70		41	49.29	do	Do.
Ludlam Landing		10	41.75		51	09.74	do	Do.
Do		10	41.66		51	09.60	do	Do.
Marlton, church tower		53	26.30		55	10.70	do	Do.
Marshall		12	13.47		41	47.00	do	Do.
Martha		40	35.87		28	13.12	do	Do.
McCrea		09	52.62		50	45.96	do	Do.
Medford		54	55.30		51	13.50	do	Do.
Miry Run		23	26.50		41	35.60	do	Do.
Moorestown, Episcopal church spire		57	45.27		57	01.69	do	Do.
Mount Laurel		56	03.50		53	39.30	do	Do.
Mountain Creek		11	46.00		39	11.34	do	Do.
Muskee Hill		18	42.20		57	08.20	do	Do.
New Germany		36	26.48		50	49.07	do	Do.
New Inlet		19	12.19		30	50.95	do	Do.
Nummy Island		01	42.70		47	28.91	do	Do.
Ocean		17	18.69		34	13.14	do	Do.
Oyster Creek		30	27.04		24	35.04	do	Do.
Page		59	09.18		07	08.18	do	Do.
Pecks Beach		16	14.97		35	11.12	do	Do.
Peters Beach		23	20.20		24	21.90	do	Do.
Phillip		53	53.37		04	45.90	do	Do.
Pierce Landing		04	57.58		54	25.38	do	Do.
Pine Hill		47	54.03		59	36.00	do	Do.
Piny Hollow		35	09.90		55	39.70	do	Do.
Public		09	03.43		44	48.17	do	Do.
Retreat, hill		53	52.20		41	47.70	do	Do.
Richland		29	18.96		51	12.59	do	Do.
Risley Landing		22	52.45		31	31.79	do	Do.
River		18	23.07		37	12.11	do	Do.
Road		15	05.28		36	53.77	do	Do.
Robinson		11	26.83		59	42.30	do	Do.
Russia		22	46.20		48	32.90	do	Do.
Ryon		22	45.09		31	33.70	do	Do.
Sea		08	59.50		42	15.64	do	Do.
Seaside Park, flagstaff at post-office		55	15.50		04	44.00	do	Do.
Smithville, mill tower		59	10.70		44	54.70	do	Do.
Somers		18	42.68		35	23.39	do	Do.
Somers Point		18	42.48		35	23.25	do	Do.
Stipson		11	54.61		54	37.91	do	Do.
Stipson Island		11	54.67		54	38.00	do	Do.
Stout		57	37.71		04	35.43	do	Do.
Tatham		06	20.34		43	31.72	do	Do.
Taunton, Hunchman's store cupola		51	12.10		51	21.40	do	Do.
Town Bank, hotel cupola		59	14.32		57	30.84	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			74°-75°				
	°	′	″	°	′	″		
Townsend	39	10	27.04	74	43	29.58	C. & G. S	Final Rept., Vol. 1.
Tuckahoe, spire		17	32.40		45	17.60	do	Do.
Tuckerton		36	10.16		19	47.82	do	Do.
View		10	39.38		43	11.40	do	Do.
Waterford, spire		43	23.90		51	09.40	do	Do.
Weakfish Creek		13	32.00		37	58.33	do	Do.
Weeks Landing		58	58.79		53	09.20	do	Do.
West Creek		10	30.30		55	04.47	do	Do.
Do		10	37.79		54	58.35	do	Do.
Weymouth		31	02.18		46	48.46	do	Do.
Stack		30	23.50		46	36.00	do	Do.
Whiting's Hotel flagstaff		57	13.04		22	46.62	do	Do.
Young		13	48.24		40	19.20	do	Do.
	39°-40°			75°-76°				
Acton	39	38	11.81	75	23	04.72	do	Do.
Allen		41	17.34		22	47.66	do	Do.
Alloway		30	15.97		31	48.92	do	Do.
Do		30	08.53		31	48.25	do	Do.
Arnold		23	17.37		25	55.00	do	Do.
Do		23	17.98		25	59.89	do	Do.
Do		23	18.03		25	59.93	do	Do.
Do		23	18.65		25	54.34	do	Do.
Baker		26	19.86		22	05.34	do	Do.
Barker		26	19.96		22	05.40	do	Do.
Ben		17	18.47		17	26.97	do	Do.
Ben Davis		17	15.36		17	29.10	do	Do.
ig Island		19	48.71		18	33.48	do	Do.
ig Mannington Hill		36	57.29		21	41.19	do	Do.
ig Timber Creek		52	45.78		06	04.94	do	Do.
illingsport		51	03.34		14	35.28	do	Do.
ird Island		11	47.61		01	29.58	do	Do.
ombay Hook light-house		21	49.49		30	38.34	do	Do.
radford Point		15	56.35		11	53.95	do	Do.
ridgeton, Baptist church spire		25	43.20		13	58.10	do	Do.
ridgeton, Chas. R. Elmer's house cupola.		25	37.20		12	50.50	do	Do.
ridgeton spire		25	46.48		13	57.71	do	Do.
uck		25	10.71		13	36.54	do	Do.
arden		31	48.94		22	52.80	do	Do.
ush		23	59.79		15	43.25	do	Do.
affery		47	31.54		13	19.13	do	Do.
amden		56	44.06		07	29.69	do	Do.
edarville		20	38.48		11	50.65	do	Do.
Spire		20	01.99		12	07.72	do	Do.
enterton		31	45.30		07	44.40	do	Do.
hester (opposite)		49	43.37		20	39.64	do	Do.
hew Hill		48	16.99		10	01.68	do	Do.
hurch Landing Point		30	39.95		31	20.27	do	Do.
ayton, church		39	26.29		05	29.73	do	Do.
hansey light-house (old)		20	21.49		21	36.88	do	Do.
opers Point		57	15.64		07	42.22	do	Do.
ove		26	13.73		28	18.14	do	Do.
ab Creek		50	39.50		17	39.73	do	Do.
retown		36	05.20		15	37.20	do	Do.
vis		22	40.55		20	31.34	do	Do.
yre		21	47.78		20	13.07	do	Do.
Do		21	47.65		20	12.97	do	Do.
erfield		32	32.20		13	24.20	do	Do.
viding Creek		15	20.22		05	23.72	do	Do.
ck Beach		20	36.34		22	10.63	do	Do.
tch Neck		23	24.10		15	13.00	do	Do.
er Cove		16	06.54		13	42.42	do	Do.
gle Island		17	49.26		14	27.10	do	Do.
gle Point		52	42.34		10	00.69	do	Do.
st Point		11	31.62		01	17.70	do	Do.
g Island		10	25.07		08	05.52	do	Do.
Light-house		10	43.82		08	13.22	do	Do.
Point		10	26.63		08	08.40	do	Do.
ler Point		12	42.86		02	51.93	do	Do.
ridge Hill		39	45.30		18	24.30	do	Do.
et		38	22.75		23	56.45	do	Do.
ner		34	57.50		11	12.70	do	Do.
Do		22	13.17		09	09.39	do	Do.
inboro		32	26.33		32	03.54	do	Do.
Do		32	27.48		32	03.46	do	Do.
inboro Point, in old Swedish fort		32	24.94		32	03.81	do	Do.
rton		22	33.37		13	12.26	do	Do.
Do		22	13.90		09	09.60	do	Do.
rview		58	28.13		03	56.89	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
False Egg Point	39	12	01.23	75	10	11.92	C. & G. S	Final Rept. Vol. 1.
Finn Point		36	00.15		33	02.57	do	Do.
Do		36	01.31		33	05.32	do	Do.
Fish club, flagstaff		53	16.54		07	43.82	do	Do.
Fish cove		58	23.87		08	53.17	do	Do.
Flax Farm		16	36.52		13	18.95	do	Do.
Fort Mifflin		52	31.67		12	45.28	do	Do.
Fortesque		14	12.65		10	19.60	do	Do.
Do		14	07.19		10	16.10	do	Do.
Big flagstaff		14	15.38		10	14.22	do	Do.
Pavilion flagstaff		14	12.23		10	19.14	do	Do.
Garrison		23	36.88		13	22.47	do	Do.
Glassboro, white spire		42	00.70		06	46.70	do	Do.
Gloucester Point		53	49.18		07	46.86	do	Do.
Greenwich		23	27.61		20	41.20	do	Do.
Haddonfield		52	53.37		02	23.30	do	Do.
Do		53	59.30		01	45.70	do	Do.
Hann		25	27.09		15	26.63	do	Do.
Harris		25	10.11		17	35.77	do	Do.
Hawkins		25	35.42		20	40.87	do	Do.
Heusted		22	58.36		18	58.15	do	Do.
Horner		57	40.85		05	42.31	do	Do.
Iona		36	10.20		04	38.20	do	Do.
Isaac		50	47.94		15	42.77	do	Do.
Jacob Creek		21	40.07		23	38.25	do	Do.
Jericho		29	19.80		21	50.20	do	Do.
Jocelyne		18	40.25		08	23.09	do	Do.
John Dayre		26	23.79		12	46.93	do	Do.
Kaighn Point		55	45.96		07	52.54	do	Do.
Kinsey		38	06.31		33	22.14	do	Do.
Laurel		26	21.44		13	43.04	do	Do.
Lippincott		43	20.56		18	49.81	do	Do.
Mahon River light-house		10	19.50		24	02.83	do	Do.
Man Island		50	22.77		19	27.99	do	Do.
Marcus Hook (opposite)		47	42.17		24	21.57	do	Do.
Mathew		51	19.64		12	42.73	do	Do.
Maurice River light-house		11	45.23		01	39.53	do	Do
Maurice River (west)		19	43.20		02	53.16	do	Do.
Merchantville, east spire		57	00.60		02	57.00	do	Do.
Mickle		54	40.31		07	22.47	do	Do.
Millville, standpipe		24	15.10		02	52.70	do	Do.
Morris		59	23.70		02	36.51	do	Do.
Morris Hill		59	24.78		02	36.76	do	Do.
Mount Pleasant		23	25.17		15	22.30	do	Do.
Mulford Landing		22	21.10		19	26.00	do	Do.
Nan		16	40.53		14	46.80	do	Do.
Nantuxent		16	36.81		14	45.49	do	Do.
New		24	09.65		26	35.13	do	Do.
New Boston		31	17.90		17	10.20	do	Do.
Newfield		32	13.84		00	16.13	do	Do.
Ogden		22	06.57		15	28.23	do	Do.
Oldman Creek		47	04.94		25	52.51	do	Do.
Oldman Point		45	40.44		27	41.32	do	Do.
Pine Mount		25	03.79		20	15.94	do	Do.
Pot		29	06.11		31	27.73	do	Do.
Port Norris		14	36.29		01	17.09	do	Do.
Powder Wharf		54	13.47		08	03.23	do	Do.
Red Bank flagstaff		52	20.45		11	20.99	do	Do.
Reedy Island light-house		30	03.37		34	08.76	do	Do.
Reeves		30	06.58		23	05.60	do	Do.
Robbin		44	34.39		20	02.15	do	Do.
Roman Catholic Seminary		29	43.26		01	37.26	do	Do.
Round		25	36.85		27	39.52	do	Do.
Round Island		25	21.99		27	33.14	do	Do.
Do		25	22.02		27	33.17	do	Do.
Do		25	27.04		27	36.01	do	Do.
Salem:								
Presbyterian church spire		34	24.10		27	59.28	do	Do.
Episcopal church spire		34	28.62		27	57.38	do	Do.
Scull		43	33.11		20	42.13	do	Do.
Do		40	59.77		20	52.29	do	Do.
Sea Breeze, Warner House flagstaff		19	26.71		19	14.83	do	Do.
Sheppard		22	41.43		21	22.81	do	Do.
Ship John light-house		18	19.10		22	37.08	do	Do.
Sneed		27	32.96		31	01.94	do	Do.
Stony		27	47.42		31	12.55	do	Do.
Do		28	01.83		31	16.12	do	Do.
Stony Point		27	33.09		31	09.25	do	Do.
Stow		22	50.27		24	51.89	do	Do.
Stringtown		40	13.30		14	18.80	do	Do.
Swedesboro, spire Episcopal church		45	02.04		18	26.72	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
Thompson Point	39	50	34.93	75	18	23.90	C. & G. S	Final Rept., vol. 1.
Tioga		58	45.36		05	14.26	do	Do.
Tomlin		13	46.84		00	09.58	do	Do.
Tonkin Island		49	14.50		22	00.34	do	Do.
Do		48	52.06		22	50.68	do	Do.
Tripod		12	36.04		02	43.10	do	Do.
Turkey Point		14	59.23		07	41.06	do	Do.
Vineland, church		29	10.17		01	16.12	do	Do.
West		45	39.83		12	20.01	do	Do.
West Point		19	06.31		15	30.23	do	Do.
Wheaton		23	29.83		19	25.40	do	Do.
Wood Point		57	28.27		05	38.73	do	Do.
Woodbury Creek		51	53.13		11	52.75	do	Do.
Woodruff		24	49.75		08	47.25	do	Do.
	38°-39°			74°-75°				
Cape May:								
Old light-house	38	55	51.84	74	57	58.50	do	Do.
New light-house		55	53.62		57	35.17	do	Do.
Congress Hall		55	54.21		55	29.37	do	Do.
Higbee		57	17.32		57	51.55	do	Do.
Two-Mile Beach		57	29.33		50	59.70	do	Do.
Weeks Landing		58	58.79		52	69.20	do	Do.

PENNSYLVANIA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			79°-80°				
	°	′	″	°	′	″		
Harbor Creek, Erie County	42	12	03.70	79	56	35.00	L. S	Final Rept.
	42°-43°			80°-81°				
Erie	42	03	41.44	80	11	11.64	do	Do.
Beacon light-house No. 2		09	11.90		04	40.20	do	Do.
Light-house		09	17.49		04	46.95	do	Do.
Standpipe of waterworks		07	53.30		05	50.80	do	Do.
Miles Grove		03	38.80		21	49.90	do	Do.
Presque Isle light-house		09	56.70		06	56.70	do	Do.
	41°-42°			75°-76°				
Bald, Lackawanna County	41	25	41.24	75	45	04.92	C. & G. S	Bull. 122.
Bald, 3, Clinton County		37	48.30		25	37.60	G. S	Do.
Bellevue, church		24	03.54		41	14.23	C. & G. S.	
Elk		42	53.84		33	30.44	do	Do.
Farview Tower		35	35.36		25	55.60	G. S	
Glen Summit		08	53.00		50	30.80	do	Do.
Hyde Park, church		24	50 78		41	03 36	C. & G. S	
Jermyn		32	29.01		34	28.58	G. S	Do.
Miller		29	20.95		59	08.86	do	Do.
Moosic		27	20.65		29	44.07	C. & G. S	
Nescopeck, 1		05	04.29		56	27.47	G. S	Do.
No. 10		24	38.74		34	20.59	C. & G. S	
Olyphant, church		28	22.88		36	23.74	do	
Panther		14	09.03		38	10.92	do	
Penobscot		10	57.14		52	21.83	do	Do.
Petersburg, church		24	38.04		38	30.25	do	
Pimple Hill		01	36.33		30	18.31	do	
Pimple, tree		01	36.79		30	20.48	do	
Providence, church		26	27.20		39	29.80	do	
Salem		33	01.48		27	26.00	G. S	Do.
Scranton, court-house		24	28.58		39	46.62	C. & G. S	
Wilkesbarre, church		14	31.77		53	03.59	do	
Woodside, church		00	37.47		54	27.42	do	
Wyoming		20	54.16		50	39.60	G. S	Do.
	41°-42°			76°-77°				
Athens	41	57	31.92	76	36	58.96	S. S	Rept. '87.
Knob		05	44.16		20	46.41	C. & G. S	Bull. 122.
Kocher		21	28.05		07	04.75	G. S	Do.
Litchfield		59	22.88		25	48.22	S. S	Rept. '87.
Nanticoke, church		12	16.01		00	01.90	C. & G. S	Do.
Nescopeck, 2		02	13.91		05	03.40	G. S	Bull. 122.
North		19	09.97		33	17.13	do	Do.
Ricketts		18	31.13		18	34.67	C. & G. S	Do.
Shickshinny		09	59.40		09	08.77	do	Do.
Warren		59	23.38		10	43.82	S. S	Rept. '87.
	41°-42°			77°-78°				
Bly	41	54	36.02	77	00	40.05	do	Do.
Friars Head		58	15.90		43	41.40	C. & G. S	Do.
Harrison		54	59.04		41	51.83	S. S	Do.

PENNSYLVANIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			80°-81°				
	°	′	″	°	′	″		
Edinboro	41	52	28.41	80	10	46.88	L. S	Final Rept.
State Line between Pennsylvania and Ohio.		59	17.70		29	08.20	do	Do.
	40°-41°			74°-75°				
Attleboro, academy cupola	40	10	53.56	74	55	17.83	do	
Belmont		08	22.41		56	48.39	do	
Briggs		12	25.09		53	37.11	do	
Bristol, Kenzey Hotel, cupola, called Posten's Hotel in 1877.		05	40.61		51	22.92	do	
Centerville		09	44.69		50	18.30	do	
China College		04	48.82		54	08.01	do	
Delanco		02	46.15		57	46.20	do	
Church spire		02	58.11		57	25.15	do	
Falsington		11	53.52		48	44.20	do	
Fisher		02	37.01		59	15.71	do	
Martingale		14	37.99		56	57.15	do	Bull. 122
Newtown		15	08.41		55	13.93	do	
Oxford		10	24.34		53	41.71	do	
Partridge		03	16.62		58	33.33	do	
Pleasantville		09	51.19		59	04.35	do	
Stackhouse		09	59.18		55	01.55	do	
Thomas		13	14.82		58	19.69	do	
Turkey Hill		09	52.02		46	29.37	do	
Watson		12	14.66		55	28.20	do	
Wynkop		12	59.80		58	45.27	do	
	40°-41°			75°-76°				
Bethlehem, Reformed church	40	37	16.77	75	22	33.44	do	
Bake Oven		44	54.11		44	02.22	do	Do.
Big Rock		33	53.73		26	16.42	do	Do.
Black Spot		20	51.15		54	09.86	do	Do.
Tower		20	50.32		54	09.73	do	Do.
Bridesburg		00	02.75		03	42.51	do	
Arsenal flagstaff (1842)		00	29.24		03	59.66	do	
Foundry		00	13.16		03	46.87	do	
Church		00	08.61		03	58.95	do	
Arsenal flagstaff (1878)		00	29.06		04	00.71	do	
Cherry Tree		02	44.04		07	20.98	do	
Chestnut Hill, flagstaff		04	35.93		12	27.57	do	
Churchville		11	36.98		01	18.43	do	
Clapier		01	12.21		10	07.82	do	
Clark		00	15.43		14	17.40	do	
Collegeville, spire		02	44.22		01	01.96	do	
Diston:								
Flagstaff		01	07.15		02	14.71	do	
Chimney		01	05.93		02	23.04	do	
Dutch Settlement, Union church		03	49.00		04	43.00	S. S	Rept. '83
Fancy Hill, Berks County		19	24.89		42	52.13	C. & G. S.	Bull. 122
Frankford:								
Pumping station		00	48.25		02	51.02	do	
Chimney		00	50.61		02	51.83	do	
Catholic church spire		00	42.48		05	25.03	do	
French		02	06.52		08	36.15	do	
George Knowles		01	17.67		01	53.53	do	
Germantown:								
Spire		01	02.16		10	48.10	do	
Church		01	55.66		10	29.23	do	
Haycock		29	18.96		13	10.34	do	
Knob		53	44.07		49	45.48	do	Do.
Kreutzer		37	15.58		31	42.05	do	Do.
Lennig:								
Square chimney		00	15.74		03	36.57	do	
Round chimney		00	21.34		03	40.29	do	
Lone Tree		48	10.50		52	43.52	do	
Long		21	28.35		42	08.79	do	Do.
Miles		11	16.96		03	13.18	do	
Pennypack		02	11.35		00	00.32	do	
Philadelphia:								
House of Correction		01	30.72		00	52.76	do	
Flagstaff		01	43.63		00	58.73	do	
Chimney		01	48.94		01	04.44	do	
St. Vincent's School cupola		01	21.10		01	53.09	do	
McKean's tower		01	11.80		10	07.75	do	
Potter's Mill, cupola		00	21.18		07	54.82	do	
Mr. George's house, flag-pole on cupola.		00	19.10		14	16.96	do	
Richard's house, cupola		00	42.13		10	46.87	do	
Port Clinton		36	15.05		59	27.82	do	Do.
Rockwell house		00	14.72		12	23.15	do	
Smith Gap		49	21.79		25	21.91	do	

PENNSYLVANIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	40°-41°	75°-76°		
	° ′ ″	° ′ ″		
upola on house	40 01 26.18	75 02 24.01	C. & G. S	
se	02 04.86	08 36.65	do	
nter line, Broad street, Phila- a.	02 04.81	08 45.58	do	
Hill:				
k tower of school	49 35.58	52 27.34	do	
byterian church spire (sharp)	49 32.57	52 23.99	do	
olic church spire (blunt)	49 27.84	52 51.57	do	
ack, chimney	49 31.95	51 27.53	do	
r tower	01 42.92	02 41.24	do	
odist church spire	01 28.92	02 34.55	do	
Point	01 26.06	01 04.88	do	
	28 37.49	40 58.25	do	Bull. 122.
k	00 33.06	03 21.12	do	
	09 10.67	03 01.80	do	
ton	01 07.64	02 11.75	do	
rove	08 31.94	06 22.28	do	
	40°-41°	76°-77°		
	40 44 15.39	76 25 42.12	do	Do.
ad	51 01.35	04 47.65	do	Do.
n	04 51.95	00 48.49	do	
	31 37.24	55 54.36	G. S	Do.
	35 42.95	37 03.20	do	Do.
	57 00.00	14 45.22	do	Do.
a	56 20.28	25 33.10	do	Do.
	21 59.05	54 32.71	C. & G. S	Do.
le	46 09.67	15 28.06	G. S	Do.
Dick	14 46.77	27 21.11	C. & G. S	
r, prison tower	02 24.58	17 33.52	do	
hanoy	44 35.47	49 56.57	G. S	Do.
	45 45.95	43 07.20	do	Do.
1	45 20.08	35 24.24	do	Do.
2	45 28.87	37 07.88	do	Do.
3	45 20.08	35 24.24	do	Do.
	56 29.82	49 00.42	C. & G. S	Do.
k, 3	59 08.98	18 46.16	G. S	Do.
op	06 13.24	55 34.14	C. & G. S	
Gap	28 15.40	32 23.52	do	
rse	30 55.19	17 33.95	do	Do.
orf	19 28.25	11 44.69	do	Do.
	52 45.62	34 33.03	G. S	Do.
	39°-40°	75°-76°		
	39 52 06.36	75 17 01.86	C. & G. S	
Reservoir	59 09.33	13 08.73	do	
	50 46.23	29 25.34	do	
	52 14.19	13 08.55	do	
	59 22.64	04 13.22	do	
se	54 48.45	25 26.01	do	
	55 00.77	13 36.05	do	
	56 43.51	08 19.31	do	
ll	53 22.52	13 29.37	do	
ley's flagstaff	50 51.75	21 35.07	do	
lic cathedral	51 05.43	21 39.13	do	
lic church	51 05.25	21 38.90	do	
all	50 52.20	21 36.86	do	
's Chemical Works chim-	50 37.28	21 26.76	do	
r's Seminary	51 21.58	22 16.78	do	
a Steel Works chimney	50 28.18	22 36.53	do	
's sugar refinery chimney	50 39.46	21 23.78	do	
& Leiper, cotton mill ney.	50 31.38	21 48.70	do	
n & Black—				
pola	51 08.29	21 06.36	do	
wmill chimney	51 03.74	21 05.19	do	
onal chimney	50 52.37	21 48.53	do	
yterian church	50 53.10	21 30.30	do	
—				
ouse	50 51.75	22 18.62	do	
fice	50 26.68	22 04.66	do	
less Dyewood Works	50 12.00	22 19.34	do	
on, paint works, chimney	51 11.46	20 32.54	do	
ll, mill chimney	50 02.18	22 38.04	do	
flagstaff	56 52.54	09 52.11	do	
	55 19.82	13 18.93	do	
ek, near mouth, engineer's	51 28.90	19 30.74	do	
	55 40.01	18 15.63	do	

PENNSYLVANIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
Delaware Lead Works	39	56	36.71	75	08	13.46	C. & G. S	
Devine's mill (near Philadelphia) cupola.		56	48.73		10	37.36	do	
East League Island		53	14.88		09	58.07	do	
Eastwicks tower, vicinity of Philadelphia.		55	51.97		12	46.09	do	
Engineer signal, on wharf at Fort Mifflin.		52	28.13		12	40.99	do	
Factory, near Philadelphia		58	40.60		08	43.25	do	
Five Mile Point		59	04.44		04	29.83	do	
Five Mile Point, 2, Harrison Wharf		59	08.49		04	19.51	do	
Fort Mifflin:								
Flagstaff (1843)		52	31.64		12	45.33	do	
Light-house (1878-79)		52	14.49		12	27.05	do	
Fuller's tower		52	18.10		19	58.60	do	
General Jeffries, tower		52	43.57		19	25.23	do	
George Hill, elevator		59	02.92		13	29.03	do	
Gloucester Ferry		53	43.25		09	50.17	do	
Glue Chimney		58	55.50		05	57.97	do	
Gray's Ferry		56	27.22		12	28.70	do	
Hog Island		52	00.87		14	19.59	do	
Jenks		59	52.82		03	53.26	do	
Kensington:								
First Presbyterian church		58	12.69		07	48.40	do	
Iron works, black derrick		57	43.22		08	02.17	do	
Water pipe		58	09.66		07	24.65	do	
Lamoken		50	40.01		22	33.06	do	
Lazaretto		51	37.03		18	11.65	do	
Cupola		51	38.84		18	01.69	do	
Flagstaff (1849-1879)		51	25.97		18	02.14	do	
Lazaretto, 2		51	36.27		18	08.21	do	
League Island		53	09.09		11	28.62	do	
Leiperville (1843-1879)		52	25.62		19	34.94	do	
Lemon Hill		58	17.53		11	21.22	do	
Logan		54	03.10		08	05.58	do	
Londonderry		51	50.51		52	50.44	do	
Lukens		51	52.49		17	57.85	do	
Maddock		52	16.99		20	00.56	do	
Maiden Island, engineer signal 3		51	21.63		15	19.60	do	
Manderson, north chimney of house		57	54.14		07	06.26	do	
Marcus Hook		48	41.39		24	44.34	do	
Baptist church		48	49.14		24	47.78	do	
Episcopal church		48	52.65		24	41.65	do	
Pioneer Iron Works chimney		48	48.36		24	38.40	do	
Tenderthorpe Club House		48	38.71		24	59.52	do	
Missimer		44	59.07		48	03.78	do	
Monument Cemetery, spire		58	54.26		09	28.10	do	
Mount Hope		52	27.55		26	28.03	do	
Movies, 2 (1884)		59	23.70		02	36.51	do	
North League Island		53	14.84		09	57.83	do	
Old Bank		54	35.43		13	34.05	do	
Old Oak Tree		54	04.17		13	00.77	do	
One		54	43.87		08	10.90	do	
Paschall		54	49.36		14	30.05	do	
Pennsylvania Military Academy		51	42.04		21	20.40	do	
Penrose Ferry, lantern of draw		53	43.68		12	33.42	do	
Philadelphia:								
Aldine Hotel		57	06.48		10	22.58	do	
Almshouse, gray chimney		56	53.61		11	44.82	do	
Arch Street church		57	12.49		09	25.86	do	
Arch Street Hotel, corner		57	06.10		08	27.73	do	
Arch Street Wharf, house		57	05.30		08	23.86	do	
Baptist church		57	16.01		11	40.77	do	
Baugh's black derrick		55	28.26		08	20.63	do	
Beck's shot tower		57	23.39		10	31.61	do	
Boiler house chimney		54	50.63		08	05.08	do	
Boston Steamship Co. (pier 20 S. W.).		56	34.81		08	30.77	do	
Brown street, river market house		57	41.25		08	13.37	do	
Burd's Orphan Asylum, cross on lower cupola.		57	43.59		15	05.08	do	
Burnt Factory, south chimney (old lazaretto).		53	19.79		12	23.61	do	
Center line of Broad street on tower of city hall.		57	10.08		09	49.86	do	
Central High School Observatory		57	47.20		09	40.81	do	
City hall—								
Center line of Broad street		57	06.85		09	50.53	do	
Main tower station (near northwest corner).		57	10.05		09	50.17	do	
Christ church		57	02.67		08	30.73	do	

PENNSYLVANIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
lphia—Continued.	°	′	″	°	′	″		
np's shears	39	58	13.52	75	07	02.39	C. & G. S	
ware avenue market house		56	39.78		08	34.15	do	
plug, Fifty-third street		57	36.48		13	37.52	do	
klin Sugar Refinery, south rret.		56	22.32		08	34.24	do	
tower (west tower near river)		55	16.90		12	09.32	do	
rd College, on roof of		58	26.60		10	13.54	do	
rd Point elevator		53	40.32		11	54.31	do	
es tower		56	54.55		08	45.48	do	
e, 1		53	54.41		08	27.87	do	
e, 2		53	41.23		09	06.73	do	
bard street wharf		56	29.01		08	30.48	do	
ket street, northeast corner wharf.		56	56.56		08	26.39	do	
ket street and Delaware ave- e.		56	59.02		08	29.70	do	
o Philips flagstaff (pier 35 W.).		56	16.70		08	29.92	do	
y-yard flagstaff		53	16.26		10	30.46	do	
y-yard signal, center of Broad eet.		53	29.78		10	37.76	do	
fie and Levy's shears		57	59.55		07	35.76	do	
high school		57	47.19		09	40.81	do	
le street wharf		57	30.70		08	12.26	do	
high school, observatory		57	05.95		09	45.20	do	
navy-yard shears		55	52.00		08	29.41	do	
street, north corner of wharf		58	05.41		07	20.93	do	
k elevator		58	17.54		11	21.31	do	
adelphia and Reading (pier S. W.).		56	42.44		08	29.56	do	
adelphia and Reading R. R. harf.		58	21.83		06	41.75	do	
-office		57	02.19		09	21.48	do	
byterian Home		55	59.82		13	37.91	do	
e Street Wharf		57	19.97		08	21.68	do	
geway House—								
Corner		56	59.01		08	29.71	do	
Flagstaff		56	59.25		08	29.76	do	
an Catholic cathedral		57	26.71		10	07.66	do	
Bonificius church		58	54.60		08	06.48	do	
ohn's church spire		58	11.87		09	43.14	do	
Paul's church		57	47.59		08	31.12	do	
Philip's Literary Institute, tagonal spire on Queen street, ar Sixth.		56	16.35		09	12.04	do	
Peter's church		56	35.34		08	53.38	do	
works chimney		54	47.95		08	19.75	do	
company's wharf		54	51.85		07	59.35	do	
w dock		57	49.99		07	56.06	do	
kamaxon street (pier 49, harfage signpost).		57	50.12		07	51.18	do	
house, south gable		53	14.68		10	38.81	do	
ks shot tower		56	05.23		08	48.00	do	
e House, cupola		56	55.64		09	09.41	do	
ersity of Pennsylvania, east wer.		57	05.11		11	37.23	do	
street ferry flagstaff		57	18.99		08	22.74	do	
t Arch Street church		57	17.57		10	10.93	do	
t Philadelphia Hall, flagstaff		57	22.25		11	46.61	do	
		59	05.80		04	45.48	do	
reeze		54	31.71		12	18.56	do	
staff		54	11.11		11	42.39	do	
nd		58	18.71		06	59.44	do	
reek		51	11.90		20	24.61	do	
on		50	12.92		23	50.97	do	
ill		53	35.90		11	42.32	do	
ill Range beacon, front (1878)		53	20.11		11	38.25	do	
ill Range beacon, rear 9).		53	27.22		11	34.95	do	
ill arsenal, flagstaff on cupola		56	26.33		11	20.16	do	
		55	59.19		08	27.31	do	
		52	58.19		14	49.91	do	
n		54	29.07		07	56.97	do	
sland		56	21.05		08	15.82	do	
staff		56	48.66		08	17.27	do	
sland, 2		56	47.97		08	09.75	do	
hester, schoolhouse		50	39.06		23	05.62	do	
eague Island, 2		53	09.13		11	28.68	do	
eague Island, Die River		53	09.12		11	28.66	do	
		52	25.01		19	34.57	do	
sville		43	55.38		47	27.54	do	

PENNSYLVANIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
Three	39	53	47.69	75	08	47.38	C. & G. S	
Thurlow		49	41.25		23	11.90	do	
Tinnicum		51	42.32		16	03.89	do	
Tioga, 2 (1884)		58	45.36		05	14.26	do	
Tonkins Island west		48	52.09		22	50.64	do	
Trainer's (E.) mill, 3		49	37.65		24	03.06	do	
Trainer's (E.) tower		49	54.54		24	34.19	do	
West Philadelphia, Presbyterian hospital.		57	30.81		11	58.50	do	
Windmill Island, 1		56	34.37		08	18.95	do	
Windmill Island, 2		56	25.88		08	14.40	do	
Windmill Island:								
South point post		56	18.84		08	15.10	do	
Chimney		56	34.34		08	14.22	do	
Yard		58	24.80		23	13.79	do	
	39°-40°			76°-77°				
Pulpit Rock	39	51	26.77	76	56	53.27	do	
Rawlinsville		53	09.54		15	58.37	do	
Winterstown		49	32.07		36	09.30	do	

DELAWARE.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
Buck, 2	39	32	26.78	75	43	55.18	C. & G. S	
Grandview		42	42.66		42	22.72	do	
Iron Hill		38	20.48		45	07.67	do	
Meetinghouse Hill		42	46.28		42	40.12	do	
Naaman Creek		48	05.47		26	32.96	do	
Naaman Creek, 2		48	17.61		26	01.06	do	
Taggart		47	29.91		27	37.10	do	

MARYLAND.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
Gray Hill	39	36	47.69	75	47	51.69	C. & G. S.	
	39°-40°			76°-77°				
Abingdon, cupola	39	27	41.50	76	16	42.21	do	
Baltimore Cemetery, brown spire		18	45.23		34	52.00	do	
Baltimore:								
City Hall cupola		17	27.12		36	39.68	do	
Fort Avenue—								
East base		15	56.51		35	05.60	do	
West base		16	19.53		36	11.32	do	
Grace church spire, Methodist		17	52.00		38	14.42	do	
Hospital (1863)		17	50.35		35	31.39	do	
Holy Cross, German Catholic church spire.		16	34.28		36	41.33	do	
Johns Hopkins, hospital cupola		17	50.25		36	36.91	do	
Sacred Heart Catholic church spire.		17	04.89		34	06.38	do	
St. James church spire		18	04.54		36	07.59	do	
St. John's church, brown spire		19	31.52		36	33.24	do	
Washington Monument, head of statue.		17	51.07		36	57.34	do	
Bay View Asylum, vane		17	23.33		33	06.73	do	
Buchanan		15	29.85		32	39.66	do	
Canton, cupola Chipman's chair factory.		16	45.92		34	44.71	do	
Chase, flagstaff on B. & O. coffee warehouse on Chase's wharf.		16	44.89		35	47.12	do	
Clifton, cupola vane		19	14.99		35	15.05	do	
Clinton		15	44.52		34	06.91	do	
Colgate		15	25.23		32	30.74	do	
De Sales, cross on cupola Mt. De Sales Carmelite convent.		17	06.57		43	19.86	do	
Druid, small spire on cupola of Druid Hill Park House.		19	24.48		38	50.44	do	
Elevator B, belfry		16	11.02		35	02.05	do	
Federal (1886)		16	48.96		36	30.17	do	
Ferry		15	33.04		36	44.83	do	
Finlay, on Cubb Hill		24	28.00		31	28.51	do	
Fishing Point		13	50.75		33	49.13	do	

MARYLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			76°-77°				
	°	′	″	°	′	″		
y Wharf	39	15	43.87	76	34	20.55	C. & G. S.	
rt Avenue:								
East base		15	56.52		35	05.60	do	
West base		16	19.53		36	11.32	do	
rt Carroll light-house (1866)		12	52.95		31	09.04	do	
rt Marshall, flagstaff (1863)		17	07.46		34	06.02	do	
rt McHenry, most easterly salient f.		15	47.38		34	45.86	do	
r McHenry (1842-1886)		15	47.47		34	46.88	do	
l and Ax, vane of tobacco factory		16	59.36		36	51.22	do	
rrity		15	01.07		31	36.44	do	
s		16	32.86		34	11.99	do	
en cupola, west end B. & O. piers and 9.		16	21.53		35	16.00	do	
en Mount Cemetery, brown spire		18	25.93		36	27.82	do	
ano factory cupola, a mill in 1866		16	43.66		36	32.94	do	
wkins Point light-house (1869)		12	28.42		31	58.38	do	
wkins Point, 2 (1866)		12	35.24		31	59.89	do	
wkins Point, 3 (1866)		12	34.80		31	57.96	do	
use of Refuge, apex of taller turret		15	51.12		43	25.70	do	
abe piano factory, cupola vane		16	38.69		37	21.17	do	
ding		13	00.74		33	00.43	do	
ding Point light-house (1869)		12	49.33		33	07.80	do	
wrence		16	19.41		36	06.71	do	
zaretto Point light-house (1843-66).		15	45.66		34	17.96	do	
sted		05	21.73		29	08.80	do	
nch. in water area		15	09.28		28	52.34	do	
Donald, house cupola		20	19.09		36	47.34	do	
ale		15	52.96		37	13.30	do	
unt Alto		19	06.20		40	33.61	do	
l		14	46.75		36	07.32	do	
re Dame Convent, lightning rod		21	05.13		37	17.50	do	
		16	18.99		40	21.11	do	
orne River		27	54.94		16	52.84	do	
us Hill		20	15.02		33	40.71	do	
acipio		35	36.69		00	16.41	do	
k Point, 2 (1866)		10	02.02		28	43.01	do	
anne		17	30.76		43	04.56	do	
ers Point, 2 (1866)		13	39.96		30	49.19	do	
ers Point, 3 (1866)		13	39.37		30	48.26	do	
ers Shore		13	54.22		31	02.42	do	
d Hill		14	51.35		35	01.61	do	
rock's Wharf, flagstaff		16	42.12		35	50.02	do	
ll white spire		16	18.14		39	27.86	do	
er		05	11.84		57	00.72	do	
ng Gardens		16	24.49		37	38.20	do	
der		07	17.71		59	06.49	do	
lor		16	48.54		35	58.11	do	
on		14	31.75		34	01.80	do	
ed States bonded warehouse, gstaff.		16	47.45		35	23.69	do	
b		05	26.05		40	32.16	do	
dall		16	15.22		35	53.25	do	
dlawn House, apex of roof		19	38.43		37	53.71	do	
	39°-40°			77°-78°				
p Hill	39	04	32.46	77	18	38.80	do	
tin, near Frederick		20	43.89		31	12.35	do	
view		39	18.10		58	10.90	do	
erick:								
rown spire, dark top		24	55.07		24	46.04	do	
utheran church—								
East spire		24	55.27		24	34.10	do	
West spire		24	55.33		24	34.78	do	
atholic church spire		24	56.97		24	28.05	do	
Knob, near Frederick		27	42.24		29	44.20	do	
Stone Ridge		10	52.64		28	29.75	do	
(J. N.), red barn, south gable		11	38.43		28	16.60	do	
land Heights, near Frederick		20	27.69		42	59.91	do	Bull. 122
's house, stone		00	25.98		11	14.80	do	
y Hill		10	24.14		28	58.22	do	
sville		08	16.22		25	11.64	do	
own hall, flagstaff on south gable		08	38.91		25	00.75	do	
ville, white spire		04	54.41		08	43.03	do	
ll Hill		13	37.17		25	08.57	do	
row Point, 2 (1866)		12	41.32		29	26.26	do	
rloaf		15	44.54		23	36.88	do	Do.
e house with wooden wing, theast chimney.		12	17.00		27	14.50	do	
	39°-40°			78°-79°				
y Creek Mountain	39	37	12.00	78	07	03.80	do	

MARYLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			79°-80°				
	°	′	″	°	′	″		
Fairfax Stone	39	43	18.00	79	28	56.60	C. & G. S	
	38°-39°			76°-77°				
Addison	38	49	30.91	76	58	44.43	do	
Annapolis		58	53.50		29	00.00	do	
Bladensburg church, east apex		56	26.09		56	27.31	do	
Brick house, cupola		58	42.67		57	33.84	do	
Hatton		42	58.51		59	15.01	do	
Hill		53	54.91		52	49.76	do	
Magruder		54	36.56		55	45.23	do	
Maryland Agricultural College		59	00.88		56	37.88	do	
Marriott		52	26.98		36	37.11	do	
Painted house, south apex		56	15.70		56	05.40	do	
Reform school		55	31.25		57	34.37	do	
Riggs, lightning rod on barn cupola		58	12.96		58	27.55	do	
Snyder, house gable		57	43.81		57	21.73	do	
Stearer, lightning rod on east chimney.		52	27.38		55	35.00	do	
Wright		54	12.13		54	34.04	do	
Yellow mill, south apex		56	31.27		56	06.12	do	
Yellow roof, white cupola		56	46.74		56	33.35	do	
Yoe (Wm.), chimney		50	17.21		57	53.52	do	
	38°-39°			77°-78°				
Blair's flagstaff	38	59	29.55	77	01	57.16	do	
Briscoe, Potomac River		40	54.56		06	21.55	do	
Bryant Point, Potomac River		41	44.06		04	06.93	do	
Carroll, lightning rod		58	43.99		00	15.58	do	
Countsman, house chimney		57	55.55		04	58.65	do	
Ferry Point		48	20.55		01	18.39	do	
Potomac River		41	49.85		06	18.33	do	
Fort Washington:								
Signal		42	45.43		02	11.14	do	
Flagstaff		42	40.34		02	06.22	do	
Glymont pavilion, Potomac River		36	36.59		08	23.75	do	
Gut Landing, Potomac river		39	50.74		06	57.60	do	
Indian Head, Potomac River		35	57.41		11	02.20	do	
Marshall Point, Potomac River		41	09.49		06	01.28	do	
Mockley Point, Potomac River		42	07.52		02	45.41	do	
North Indian Head, Potomac River		36	24.02		10	12.79	do	
Oxon Hill		47	58.52		00	23.69	do	
Pamunkey Creek		38	04.12		06	39.74	do	
Port Tobacco court-house, cupola		30	40.77		01	14.18	do	
Pye's Wharf, Potomac River		36	41.87		08	15.33	do	
Rosier Bluff, Potomac River		46	20.32		01	51.15	do	
Rozier (C.), west gable of house		46	31.47		01	08.63	do	
Simmons		57	07.74		05	53.41	do	
Stevenson, Potomac River		40	16.03		06	54.05	do	
Stump Neck, Potomac River		33	15.66		13	29.60	do	
Sumner		57	18.77		07	30.77	do	
White Stone Point, Potomac River		40	34.37		07	48.85	do	

DISTRICT OF COLUMBIA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			76°-77°				
	°	′	″	°	′	″		
Fort Dupont, flagstaff	38	52	22.40	76	56	26.10	C. & G. S	
	38°-39°			77°-78°				
Apex Washington Monument	38	53	22.02	77	02	07.78	do	
Capitol, head of statue		53	23.25		00	33.55	do	
Causten		55	35.29		04	23.81	do	
Georgetown College, observatory		54	29.94		04	39.05	do	
Insane Asylum		51	17.18		00	00.92	do	
Kengley's house, lightning rod on southeast chimney.		55	34.56		04	26.12	do	
Soldiers' Home		56	29.85		00	40.48	do	
Wayland Seminary		55	17.33		02	08.53	do	
Naval Observatory, pole on dome		53	42.25		06	06.10	do	
Station east of dome		53	42.31		03	05.81	do	

VIRGINIA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			77°-78°				
	°	′	″	°	′	″		
Distant lone tree	39	04	49.60	77	39	00.20	C. & G. S	
Leesburg		07	45.62		35	06.16	do	
Maryland Heights		20	27.69		42	59.91	do	Bull. 123.
Maryland Heights (S.)		20	09.97		43	09.14	do	

VIRGINIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
		39°-40°			77°-78°			
	°	′	″	°	′	″		
Old Pine Tree Hill	39	11	31.23	77	34	20.62	C. & G. S	
Whitehouse, chimney on northeast gable.		11	08.90		33	19.10	do	
		39°-40°			78°-79°			
Capon Mountain	39	08	33.30	78	26	06.40	do	Bull. 122.
Lockhart		14	12.60		19	17.00	do	
Locks		26	27.20		11	33.40	do	
Rock Enon		10	39.30		23	23.90	do	
Shockey		23	25.80		13	47.50	do	
Alexandria:		38°-39°			77°-78°			
Baptist church	38	48	23.25	77	02	40.58	do	
Christ church		48	22.64		02	52.37	do	
High School		49	27.91		05	40.05	do	
Northern coal wharf		48	51.11		02	11.94	do	
Hotel tower		48	19.10		02	32.65	do	
Theological Seminary, near, new spire cross.		49	13.53		05	31.33	do	
Market House cupola		48	19.57		02	36.74	do	
Pioneer Mills chimney		48	05.96		02	24.75	do	
Machine shop, brown cupola		48	37.15		02	44.84	do	
St. Mary's church		48	06.70		02	39.27	do	
Arlington, flagstaff in front of mansion house.		52	52.10		04	21.10	do	
Arlington House, east apex		52	52.15		04	21.89	do	
Big Cobbler Mountain		50	21.00		57	11.00	do	
Bull Run		52	53.58		42	12.61	do	Do.
Cockpit Point, Potomac River		33	22.77		15	46.45	do	
Culpeper Court-house, flag		28	25.58		59	51.27	do	
Dangerfield		49	45.05		02	19.44	do	
Ellsworth		48	30.02		04	09.94	do	
Erin		46	48.60		06	54.50	do	
Falls Church		52	52.39		10	13.15	do	
Fredericksburg, Episcopal church spire.		18	09.57		27	35.33	do	
Fort Myer, flagstaff		53	07.75		04	39.60	do	
Fowle, house cupola		47	47.26		05	48.54	do	
Gillingham, house chimney		46	37.44		04	56.81	do	
Gravelly		52	00.93		02	12.47	do	
Gunston Cove, Potomac River		39	20.07		08	39.11	do	
Hallowing Point, Potomac River		38	05.56		07	51.72	do	
Hall, house cupola		54	19.89		07	44.82	do	
Hamersley		45	28.66		04	09.49	do	
Hospital, cupola		52	03.81		04	07.52	do	
Hell Hole Point, Potomac River		46	00.70		02	29.01	do	
Hunter		50	45.37		02	23.21	do	
Hunting Creek Bridge, flag		47	33.46		03	24.92	do	
Johnson, house chimney		47	21.77		04	18.76	do	
Jones Point light-house (1863)		47	25.34		02	27.12	do	
angley church, south gable		56	51.05		09	37.83	do	
ewinsville church, south gable		55	46.73		11	50.65	do	
yon		47	26.43		04	37.79	do	
arcy		56	06.15		07	35.62	do	
iner Hill		54	23.89		09	33.61	do	
ount Vernon wharf signboard, Potomac River.		42	19.47		05	19.89	do	
unson Hill, flag		51	36.30		08	44.10	do	
ccoquan		38	14.30		12	59.75	do	
each Grove		55	12.74		13	46.77	do	
ort Royal		10	24.09		11	24.63	do	
ocker (A.), chimney on house		46	43.28		05	55.65	do	
hipping Point, Potomac River		31	38.44		17	00.07	do	
trong		53	49.24		05	20.10	do	
quare yellow house, cupola		49	09.03		04	41.26	do	
elegraph pole		52	39.51		02	10.07	do	
pton Hill		52	19.50		06	49.99	do	
iew Tree, near Warrenton		44	01.97		50	09.98	do	
atery Mountain		47	32.00		50	23.00	do	
hite house, cupola		51	32.32		04	00.76	do	
orth		48	52.90		05	55.56	do	
		38°-39°			78°-79°			
luff Mountain	38	26	26.00	78	25	00.00	do	
lark		18	41.11		00	11.49	do	Do.
orks		28	44.81		24	57.47	do	Do.
awksbill		33	19.00		23	44.00	do	
igh Knob, probably Fire Mountain, outh side of Manassas Gap, Blue Ridge.		53	12.13		06	43.84	do	Do.
annau		06	18.53		44	38.69	do	
eller		55	08.99		23	31.30	do	

VIRGINIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			78°-79°				
	°	′	″	°	′	″		
Marshall	38	46	33.82	78	12	10.28	C. & G. S	Bull. 122.
Mary Rock		38	53.00		19	26.00	do	
McCormick Observatory, pier		01	58.06		31	20.62	do	
Peaked		23	33.97		46	12.63	do	
Peters Mountain		07	32.80		17	10.71	do	
Ragged Rock		32	06.00		18	54.00	do	
Rattlesnake		51	53.00		02	36.00	do	
Saddle Mountain		20	09.00		33	07.00	do	
Stonyman Mountain		35	52.00		22	20.00	do	
Strasburg		59	31.40		21	33.70	do	
Astronomical station		59	29.96		21	39.01	do	
Lutheran church		59	26.80		21	44.70	do	
Presbyterian church		59	12.21		21	46.37	do	
Thoroughfare Mountain, summit		24	52.00		09	25.00	do	
Turks Mountain		18	16.00		38	45.00	do	
University of Virginia, dome		02	08.31		30	13.01	do	
	38°-39°			79°-80°				
Elliott Knob	38	09	59.36	79	18	51.30	do	Do.
Flag Rock		02	33.00		46	23.00	do	
North		51	28.90		48	20.20	G. S	Do.
North River Mountain		23	39.00		15	29.00	C. & G. S	
Northeast Peak		09	45.00		31	19.00	do	
Shenandoah, Jack Mountain		24	22.00		30	48.00	do	
Sounding Knob, lone tree		20	47.00		35	25.00	do	
Staunton, astronomical station		08	46.54		04	19.08	do	
	37°-38°			76°-77°				
Fortress Monroe, flagstaff	37	00	05.93	76	18	32.10	do	
Tappahannock, Episcopal church spire.		55	39.38		51	31.35	do	
Yorktown		16	09.64		30	28.38	do	
Petersburg:	37°-38°			77°-78°				
Court-house	37	13	50.74	77	24	13.56	do	
Catholic church		13	38.65		24	24.29	do	
Presbyterian church		13	49.03		24	19.41	do	
Methodist church		13	39.77		24	09.73	do	
Richmond:								
Baptist College tower		33	08.94		27	21.32	do	
Capitol, flag pole on east end of building.		32	16.38		26	04.04	do	
Capitol, flagstaff on center of building.		32	19.50		26	01.66	do	
St. Paul's church		32	23.48		26	06.82	do	
Roslyn:								
Astronomical station		14	28.33		23	50.71	do	
Petersburg transit		14	25.48		23	45.14	do	
	37°-38°			78°-79°				
Baker	37	12	09.57	78	38	39.19	G. S	Do.
Humpback		56	55.91		53	57.24	C. & G. S	Do.
Leigh		12	14.21		21	32.82	G. S	Do.
Mountain southwest of Humpback		54	58.00		57	16.00	C. & G. S	
Pilot Mountain, summit		19	30.00		58	05.00	do	
Spear		33	42.91		45	46.66	do	Do.
Sugarloaf, summit		46	57.00		49	16.00	do	
Three Ridge, summit		51	29.00		59	02.00	do	
Willis		28	22.68		27	52.90	do	
	37°-38°			79°-80°				
Amherst court-house cupola	37	35	06.30	79	03	04.30	do	
Apple Orchard, summit		31	03.00		30	41.00	do	
Bald Friar, summit		49	12.00		03	42.00	do	
Bald Knob		55	32.64		51	04.72	do	
Bald Knob, No. 1		51	00.00		55	35.00	do	
Big Level Mountain, lone tree		56	34.00		06	47.00	do	
Brushy		00	37.16		19	41.32	G. S	Do.
Campbell court-house, jail		16	33.30		06	11.60	C. & G. S	
Chandler Mountain, summit		20	12.00		08	12.00	do	
Cole Mountain		45	06.00		12	19.00	do	
Covington, transit		47	17.00		59	38.40	do	
Dry Mountain		06	22.90		03	47.99	G. S	Do.
First peak northeast of Flat Top, summit.		28	47.00		32	44.00	C. & G. S	
Flat Top		27	06.85		34	58.40	do	Do.
Johnson		11	32.78		21	42.56	G. S	Do.
Johnson Mountain, summit		11	51.00		21	06.00	C. & G. S	Do.
Long		17	27.65		05	10.24	do	
Lynchburg court-house, belfry		24	49.10		08	40.52	do	
Mount Pleasant, summit		44	27.00		10	17.00	do	
Mountain northwest of Mount Pleasant.		44	24.00		13	25.00	do	

VIRGINIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	37°-38°			79°-80°				
	°	′	″	°	′	″		
No Business Mountain, summit	37	28	13.00	79	22	35.00	C. & G. S	
Northeast House Mountain		49	45.00		32	36.00	do	
Rocky Mountain		46	01.00		11	16.00	do	
Round Top, near James River		28	08.00		00	27.00	do	
Second peak northeast of Flat Top		29	46.00		30	55.00	do	
Southwest House Mountain		49	51.00		33	43.00	do	
Southwest peak of Otter, summit		26	00.00		36	18.00	do	
Smith		00	51.53		33	56.93	do	Bull. 122.
Tobacco Row		33	55.76		11	26.17	do	Do.
Tyrecana church		23	27.70		06	18.30	do	
Weavers Knob summit		18	14.00		49	25.00	do	
	37°-38°			80°-81°				
Buckhorn	37	17	33.55	80	58	49.30	G. S	Do.
Cahas		07	01.95		00	56.64	do	Do.
Peak		01	22.00		44	54.50	do	Do.
Potts		36	02.90		08	45.00	do	Do.
Salt Pond		21	00.80		32	15.30	do	Do.
Streets		09	46.10		11	33.90	do	Do.
	37°-38°			81°-82°				
Bear Wallow	37	14	38.60	81	44	50.20	do	Do.
Big Bend		01	37.80		10	56.40	do	Do.
Dial Rock		09	58.40		25	00.30	do	Do.
Morris		02	57.50		37	01.60	do	Do.
	37°-38°			82°-83°				
Big Butt	37	03	09.20	82	02	08.00	do	Do.
	36°-37°			76°-77°				
Newport News	36	58	00.81	76	25	21.52	do	
Norfolk:								
Baptist church spire		51	01.31		17	13.75	do	
City hall		50	50.59		17	19.95	do	
	36°-37°			79°-80°				
Chestnut Mountain, summit	36	50	54.00	79	50	46.00	do	
Turkey		50	11.19		39	28.25	do	Do.
White Oak		42	51.80		25	34.90	do	Do.
	36°-37°			80°-81°				
uffalo	36	47	46.25	80	28	39.04	C. & G. S	Do.
ull Mountain		41	34.97		13	29.93	do	
raper		57	56.70		53	53.50	G. S	Do.
ich		34	37.60		49	31.90	do	Do.
	36°-37°			81°-82°				
okout	36	40	04.50	81	10	03.20	do	Do.
ed Rock		55	20.00		48	22.00	do	Do.
pshin		50	28.30		21	37.80	do	Do.
gers		39	36.10		32	42.00	do	Do.
hite Top		38	21.76		36	12.48	do	Do.
	36°-37°			82°-83°				
inch	36	49	44.50	82	04	46.00	do	Do.
odson		35	49.10		11	13.10	C. & G. S	
gh Knob		53	33.00		37	46.10	G. S	Do.

WEST VIRGINIA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			80°-81°				
	°	′	″	°	′	″		
heeling	40	04	04.00	80	43	36.60	C. & G. S	Rept. '84.
	39°-40°			78°-79°				
pon	39	08	36.40	78	26	03.70	do	Bull. 122.
ks		26	27.20		11	33.40	do	
ddy		00	24.40		33	47.70	G. S	Do.
epy Creek Mountain		37	12.00		07	03.00	C. & G. S	
	39°-40°			79°-80°				
lton	39	23	21.70	79	39	07.10	G. S	Do.
urel		09	34.70		49	42.50	do	Do.
lson		27	53.30		56	06.20	do	Do.
	39°-40°			80°-81°				
r Knob	39	03	25.10	80	17	23.70	do	Do.
neron		49	46.00		34	22.50	C. & G. S	Rept. '84.
rksburg		16	56.00		20	22.05	do	Do.
afton					01	40.80	do	Do.
tle Bald		20	09.10		14	22.70	G. S	Bull. 122.
king Creek		01	17.60		51	56.80	do	Do.
ar Loaf		02	02.75		33	49.70	do	Do.

WEST VIRGINIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			79°-80°				
	°	′	″	°	′	″		
Bickles	38	56	08.40	79	43	54.40	G. S	Bull. 122.
Briery Branch Mountain		27	45.30		14	31.30	C. & G. S	Do.
Green		53	50.70		28	36.70	G. S	Do.
North		51	28.90		48	20.20	do	Do.
Paddy		15	56.77		47	46.29	do	Do.
Panther Knob		34	07.00		10	14.90	C. & G. S	Do.
Panther		33	48.30		29	45.30	G. S	Do.
Rich		50	01.85		56	22.60	do	Do.
Slate Springs		30	35.71		11	03.66	do	
Spruce		41	58 70		31	59.50	do	Do.
	38°-39°			80°-81°				
Big Run	38	47	41.90	80	15	30.15	do	Do.
Beech		06	44.63		36	18.88	do	Do.
Briery		08	39.65		20	40.40	do	Do.
Cedar Creek		54	30.30		53	52.70	do	Do.
Cold Knob		03	43.00		28	30.00	C. & G. S	
Grassy Knob		03	20.00		30	14.00	do	
High Knob		15	46.10		12	20.80	do	
Locust		53	28.15		41	06.65	G. S	Do.
Job Knob		04	46.70		32	32.65	C. & G. S	
Nicholas court-house belfry		16	50.50		52	02.50	do	
Powell Mountain		18	10.00		48	37.00	do	
Rush		55	25.00		32	42.60	G. S	Do.
Summersville		16	55.42		52	07.65	C. & G. S	Do.
	38°-39°			81°-82°				
Big Rocks	38	30	51.23	81	55	29.23	do	
Charleston		21	07.20		38	00.00	do	Rept. '84.
Creed		24	16.82		33	35.50	do	
Elk		22	20.73		36	56.57	G. S	
Ferguson		20	37.96		38	14.93	C. & G. S	
Fort Scammon		21	06.32		39	16.94	G. S	
Gauley Bridge		09	08.70		12	57.00	C. & G. S	
Gauley Mountains		10	50.00		04	27.00	do	
Do		10	53.00		04	19.00	do	Bull. 122.
Holmes		25	40.87		35	34.31	do	Do.
Martin		21	25.36		36	18.14	do	
Table Rock		11	18.56		36	53.13	do	Do.
	38°-39°			82°-83°				
Davis	38	21	06.31	82	21	12.15	do	
Gebhardt		31	45.73		15	10.88	do	
Oakland		21	46.57		38	52.68	do	
Pigeon		13	44.13		03	59.86	do	
Piney		26	39.66		03	28.84	do	
Point Pleasant		50	28.00		08	45.30	do	Rept. '84.
	37°-38°			80°-81°				
Big Clear Creek Mountain	37	57	52.00	80	36	05.00	do	Do.
Big Sewall Mountain		54	35.40		55	42.36	do	Do.
Keeney		46	24.91		42	19.05	do	Do.
	37°-38°			81°-82°				
Burning Rock	37	41	38.00	81	41	51.60	G. S	Bull. 122.
Ivy		47	15.78		29	28.28	C. & G. S	
Long Flat Mountain		53	18.00		25	46.00	do	
Do		53	16.00		26	00.00	do	
Paint Creek		56	50.79		18	28.82	do	Do.
Pilot		29	04.30		16	18.80	G. S	Do.
Sharp Peak		53	56.00		19	52.00	C. & G. S	
Townsend Mountain		56	30.00		17	43.00	do	

NORTH CAROLINA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	36° 37°			80°-81°				
	°	′	″	°	′	″		
Lauratown	36	22	33.00	80	22	17.00	C. & G. S	
Moore		23	53.60		16	59.24	do	
Pilot Knob		20	24.53		28	28.19	do	
Warrior Mountain		29	13.00		51	45.00	do	
	36°-37°			81°-82°				
Bullhead	36	26	49.70	81	04	00.70	do	Bull. 122.
Elk Knob		20	40.00		42	31.00	do	
Flat Top Mountain, Blue Ridge		09	44.00		40	37.00	do	
Grandfather		06	41.50		48	36.90	do	Do.
Negro		24	11.60		27	48.70	do	Do.
Poore		02	47.66		09	24.24	do	Do.
Snake		19	51.10		42	28.20	do	Do.

NORTH CAROLINA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	35°-36°			80°-81°				
	°	′	″	°	′	″		
Statesville astronomical station	35	46	56.55	80	53	39.94	C. & G. S	
Statesville, Simonton College		46	57.94		53	39.05	do	
Young		44	14.49		38	51.16	do	Bull. 122.
	35°-36°			81°-82°				
Anderson	35	33	57.32	81	05	28.80	do	
Benn		33	55.06		37	37.55	do	Do.
Hibriton		54	25.40		29	22.70	G. S	Do.
King		12	27.87		18	45.59	C. & G. S	Do.
Lincolnton court-house cupola		28	16.87		15	25.67	do	
Table Rock		53	27.70		52	59.00	G. S	Do.
Thicketty		06	48.24		46	08.21	C. & G. S	
	35°-36°			82°-83°				
alsam	35	22	02.10	82	59	24.70	G S	Do.
ig Bald		59	23.50		29	25.00	do	Do.
itchell		45	53.60		15	54.50	do	Do.
isgah		25	32.50		45	24.60	do	Do.
andymush		40	41.70		53	01.40	do	Do.
	35°-36°			83°-84°				
heowah	35	19	32.20	83	40	30.70	do	Do.
hristie Peak		23	09.40		58	10.10	do	Do.
owee		19	39.90		20	10.00	do	Do.
homas Bald		02	07.30		32	16.80	do	Do.
hunderhead		34	06.80		42	22.50	do	Do.
usquittah		08	42.50		43	35.20	do	Do.
	35°-36°			84°-85°				
aw Knob	35	18	34.20	84	01	35.20	do	Do.
ack		03	00.90		17	10.00	do	Do.

SOUTH CAROLINA.

	35°-36°			82°-83°				
	°	′	″	°	′	″		
gback	35	10	12.25	82	17	26.34	C. & G. S	Bull. 122.
nnacle		02	00.85		44	30.02	do	Do.
	34°-35°			81°-82°				
offord	34	57	32.31	81	56	06.73	do	Do.
eenville:	34°-35°			82°-83°				
Baptist spire	34	50	59.78	82	24	05.08	do	
Episcopal spire cross		51	02.58		23	40.79	do	
Furman University turret		50	29.15		24	11.34	do	
White tower, conical dark roof		50	55.36		23	44.33	do	
uldin		49	18.46		38	05.09	do	Do.
rs		56	29.27		24	40.05	do	Do.

GEORGIA.

	34°-35°			83°-84°				
	°	′	″	°	′	″		
od	34	44	23.24	83	56	13.22	C. & G. S	Bull. 122.
rrahee		31	45.13		22	33.32	do	Do.
hlonega Agricultural College, enter of roof.		31	47.95		59	13.25	do	
bun		57	55.74		17	59.26	do	Do.
tt		30	20.55		43	19.83	do	Do.
	34°-35°			84°-85°				
utta	34	53	23.51	84	34	26.44	do	
ssy		29	10.58		19	53.04	do	Do.
e Log		19	18.31		38	13.66	do	Do.
Mountain		10	36.61		44	41.67	do	
rnee		14	12.12		09	38.83	do	Do.
rp Top Mountain		26	21.00		30	26.00	do	
eat		04	01.44		27	21.54	do	Do.
	34°-35°			85°-86°				
sa	34	13	59.30	85	14	04.32	do	
f		37	32.16		28	02.49	do	Do.
h Point		51	49.80		23	32.70	G. S	Do.
ns Mountain		37	23.23		05	53.77	C. & G. S	Do.
nt Lavender		19	19.57		17	18.39	do	Do.
ky Face		49	26.30		00	28.10	G. S	Do.

GEORGIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	33°-34°			81°-82°				
	°	′	″	°	′	″		
Augusta:								
Astronomical station in post-office grounds.	33	28	20.60	81	57	55.40	C. & G. S.	
Post-office flagstaff		28	22.18		57	53.96	do	
	33°-34°			83°-84°				
Academy	33	57	32.66	83	59	28.51	do	
Atlanta:	33°-34°			84°-85°				
Barracks flagstaff	33	44	38.99	84	24	39.95	do	
Capitol flagstaff		45	19.32		23	29.15	do	
Carnes Mountain		59	35.76		00	50.03	do	
Kenesaw		58	34.37		34	45.74	do	
Lost Mountain		56	52.74		41	50.75	do	
Marietta:								
Court-house, brown spire		57	08.74		32	55.92	do	
National Cemetery flagstaff		57	04.15		32	30.60	do	
Middle base		54	21.74		16	37.79	do	
Northeast base		55	57.86		14	09.44	do	
Southwest base		52	51.83		18	56.41	do	
Stone Mountain		48	22.07		08	45.89	do	
	32°-33°			83°-84°				
Macon, transit near Academy	32	50	25.38	83	37	33.82	do	

FLORIDA.

	29°-30°			82°-83°				
	°	′	″	°	′	″		
Gainesville:								
Astronomic station	29	39	07.90	82	19	20.90	C. & G. S.	
Court-house rod		39	04.53		19	23.80	do	
	29°-30°			84°-85°				
Apalachicola, flagstaff	29	43	30.00	84	59	00.00	do	
	27°-28°			82°-83°				
Alafia	27	50	04.46	82	23	22.06	do	
Ball		54	23.27		24	51.27	do	
Catfish Point		50	43.47		28	06.75	do	
Fort Brooks, barracks cupola		56	33.24		27	21.57	do	
Gadsden Point		49	19.74		28	15.05	do	
Geode		53	19.96		28	43.30	do	
Island		55	24.73		27	07.72	do	
Stick		53	23.90		24	19.60	do	
Old		51	52.11		23	58.72	do	

ALABAMA.

	34°-35°			85°-86°				
	°	′	″	°	′	″		
Brandon	34	23	07.35	85	45	12.72	C. & G. S.	Bull. 122.
Indian		01	49.94		25	31.10	do	Do.
Weisner		01	36.63		40	27.43	do	
	34°-35°			86°-87°				
Athens, court-house spire	34	48	10.56	86	58	17.46	do	
Aurora		08	47.87		11	00.80	do	
Capshaw		49	04.47		44	17.40	do	
Gunter		34	06.83		10	20.30	do	Do.
Huntsville:								
Episcopal church spire		43	49.38		35	00.20	do	
Cupola of court-house		43	49.09		35	06.02	do	
Knob Valhermosa		30	53.15		38	36.98	do	
Madkin Mountain-tree		40	02.10		38	37.88	do	
Monte Sano, north end		44	52.10		32	03.54	do	
Moore Hill		21	32.50		15	53.56	do	
Rowe Mountain		32	22.32		31	26.59	do	
Smither		48	59.20		36	58.34	do	
Summit		12	16.36		29	05.20	do	
Wilson Mountain		25	07.51		49	02.85	do	
	34°-35°			87°-88°				
Penit	34	26	08.90	87	20	14.29	do	
	33°-34°			85°-86°				
Chehahaw	33	29	08.03	85	48	31.14	do	
	33°-34°			86°-87°				
Alpine	33	24	41.50	86	12	28.20	do	
Cahaba		44	58.80		31	24.60	do	

ALABAMA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	33°-34°			86°-87°				
	°	′	″	°	′	″		
Columbian	33	11	40.80	86	35	00.70	C. & G. S	
Horn		17	51.40		04	29.70	do	
Kahatchee		13	36.80		21	38.60	do	
Laurel		23	50.20		34	53.80	do	
Warnock		59	48.67		41	51.96	do	
	32°-33°			86°-87°				
Jamison	32	55	39.20	86	38	38.40	do	
Montgomery		22	45.46		17	57.29	do	Rept. '84.
Weogufka		58	38.70		21	20.20	do	Do.
Wilder		38	01.77		29	38.53	do	Do.
	31°-32°			85°-86°				
Eufaula	31	53	40.91	85	08	18.62	do	Do.

MISSISSIPPI.

	34°-35°			90°-91°				
	°	′	″	°	′	″		
dams	34	34	15.16	90	33	57.10	Miss. R. C	Rept. '87.
lexander		43	16.01		30	39.08	do	Do.
nderson		08	57.54		53	14.45	do	Rept. '82.
ustralia		04	01.51		53	17.63	do	Do.
attle Island		39	02.60		28	59.63	do	Rept. '87.
elfor		28	32.01		34	05.72	do	Rept. '82.
ennett		50	49.74		20	06.11	do	Rept. '87.
owie Point		50	45.81		21	31.44	do	Do.
ordeaux Chute		44	52.78		30	12.88	do	Do.
rinkley		45	45.18		25	25.75	do	Do.
uck Island		51	37.17		18	55.16	do	Do.
Chute		52	11.57		18	13.53	do	Do.
uckshot		35	32.69		33	13.97	do	Do.
uzzard		16	06.23		47	50.96	do	Rept. '82.
arter		44	53.77		29	33.76	do	Rept. '87.
emetery		32	36.78		35	36.59	do	Rept. '82.
lark		47	37.99		26	03.07	do	Rept. '87.
ommerce		48	55.18		26	09.27	do	Do.
ottonwood		51	22.86		21	45.26	do	Do.
rews		07	08.75		56	05.31	do	Rept. '82.
elta		24	44.55		35	11.90	do	Do.
ennis		02	15.36		54	17.38	do	Do.
onaldson		13	49.01		51	31.98	do	Do.
yers		02	55.05		53	39.02	do	Do.
rederick		40	09.42		27	33.19	do	Rept. '87.
riar Point		22	54.28		37	53.29	do	Rept. '82.
lendale		30	09.51		34	19.11	do	Do.
rider		54	59.21		15	59.59	do	Rept. '87.
ratlin		11	53.25		50	54.04	do	Rept. '82.
arcklerode		56	29.35		14	40.59	do	Rept. '87.
elena Island		34	41.48		32	16.20	do	Do.
orseshoe Lake		52	41.57		18	31.27	do	Do.
ulberton		17	07.70		47	02.72	do	Rept. '82.
urricane Point		02	04.31		55	07.21	do	Do.
land 64		14	26.29		51	10.74	do	Do.
land 66		10	58.31		49	36.36	do	Do.
land 69		04	36.71		54	14.06	do	Do.
ckson Point		14	10.52		52	49.62	do	Do.
hn H		54	15.75		17	13.95	do	Rept. '87.
mes		10	05.69		49	21.65	do	Rept. '82.
amb		55	11.65		15	13.72	do	Rept. '87.
cker		21	29.59		41	15.70	do	Rept. '82.
agenta		01	54.29		56	08.87	do	Do.
alone		08	43.89		51	55.52	do	Do.
iller Point		22	29.43		42	40.86	do	Do.
ontezuma		26	25.63		35	04.60	do	Do.
oon Lake		44	18.52		27	02.10	do	Rept. '87.
ew Hope		08	40.33		50	57.01	do	Rept. '82.
asis		00	27.02		57	15.61	do	Do.
K		38	02.19		28	52.78	do	Rept. '87.
erflow		19	57.67		44	05.46	do	Rept. '82.
rker		06	35.55		55	25.05	do	Do.
rry		42	10.17		29	33.42	do	Rept. '87.
aton		44	22.15		30	39.14	do	Do.
lk		50	40.81		22	46.48	do	Do.
shmataha		09	19.85		55	21.60	do	Rept. '82.
itman		11	50.49		52	03.50	do	Do.
chardson		11	47.29		49	12.65	do	Do.
binsonville		09	10.79		49	09.90	do	Do.

MISSISSIPPI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	34°-35°			90°-91°				
	°	′	″	°	′	″		
Robson	34	15	00.53	90	48	56.60	Miss. R. C	Rept. '82.
Rozzell		23	23.01		36	55.84	do	Do.
Russell		18	39.71		43	36.73	do	Do.
St. Johns		05	29.39		54	02.32	do	Do.
Sand Point		49	52.64		24	30.51	do	Rept. '87.
Sandford		01	04.44		56	56.25	do	Rept. '82,
Ship		21	43.15		38	57.13	do	Do.
Shoo-Fly		38	55.08		31	23.40	do	Rept. '87.
Star Landing		54	14.02		15	56.80	do	Do.
State Land		20	48.90		44	28.32	do	Rept. '82.
State Levee		13	55.44		50	36.04	do	Do.
State Line		58	50.03		16	29.40	do	Rept. '87.
Sunflower Landing		10	23.83		48	37.70	do	Rept. '82.
Turner		38	29.74		33	50.58	do	Rept. '87.
Ude		32	12.74		33	44.53	do C. & G. S.	Rept. '82.
Wilkinson		21	58.88		44	36.95	Miss. R. C	Do.
Williams		52	36.22		17	31.83	do	Rept. '87.
Yazoo Pass		26	16.44		33	18.66	do	Rept. '82.
	34°-35°			91°-92°				
Smith Point	34	00	16.86	91	02	20.43	do	Do.
	33°-34°			90°-91°				
Bee Hive	33	59	00.01	90	59	51.11	do	Do.
Brandenburg		59	04.45		58	15.48	do	Do.
Hill		58	44.65		59	13.45	do	Do.
Island 71		59	36.32		57	55.16	do	Do.
Judge E		57	55.68		58	26.05	do	Do.
North Base		59	52.48		56	44.91	do	Do.
R. Jones		58	27.85		59	56.60	do	Do.
South Base		59	11.37		57	01.86	do	Do.
	33°-34°			91°-92°				
Antler	33	59	20.92	91	01	23.58	do	Do.
Argyle		26	56.00		04	47.15	do	Do.
Ashbrook		28	45.81		18	03.28	do	Do.
Ashland		27	54.03		07	13.05	do	Do.
Bar		03	02.17		08	32.72	do	Rept. '87.
Bar Point		35	05.36		12	43.41	do	Rept. '82.
Barnes		27	23.83		12	12.98	do	Do.
Beulah Lake		48	03.19		03	40.71	do	Do.
Buck Ridge		39	57.49		04	30.87	do	Do.
Campbell		26	54.00		05	48.00	do	Do.
Carolina		00	37.13		09	12.36	do	Rept. '87.
Gin, northwest gable		00	39.45		09	05.19	do	Do.
Carter		26	14.45		07	06.06	do	Rept. '82.
Catfish Point		42	00.56		09	12.12	do	Do.
Chaff		08	43.77		08	02.10	do	Rept. '87.
Childers		38	09.99		08	33.13	do	Rept. '82.
Compton		16	00.59		06	51.26	do	Rept. '87.
Concordia Bayou		58	21.37		02	48.89	do	Rept. '82.
Content		39	55.07		07	05.07	do	Do.
Cottage		08	06.06		09	26.41	do	Rept. '87.
Craig's gin chimney		22	19.57		08	34.82	do	Do.
Crow Point		46	09.61		07	57.18	do	Rept. '82.
Cypress Tow Head		42	30.01		11	32.55	do	Do.
Deer Point		43	00.14		04	56.05	do	Do.
Delolme		35	54.63		10	19.27	do	Do.
Dry Chute		44	03.73		07	13.14	do	Do.
Duncan		33	05.78		12	46.47	do	Do.
Easton		36	38.67		07	57.83	do	Do.
Eutaw		38	54.64		09	36.14	do	Do.
Eutopiot		29	53.98		11	33.30	do	Do.
Ezell		52	32.69		02	53.38	do	Do.
Fisher		45	30.82		05	56.25	do	Do.
Floryville		51	07.77		01	59.48	do	Do.
Gill		59	07.89		03	37.70	do	Do.
Glenora		11	53.28		04	44.11	do	Rept. '87.
Gin chimney		11	12.52		04	07.66	do	Do.
Greenville:								
Episcopal church spire		24	40.21		03	57.30	do	Do.
Base, north end		24	19.23		03	58.77	do	Do.
Base, south end		23	18.19		04	32.44	do	Do.
Highland		21	14.06		08	23.76	do	Do.
Hill		08	11.60		07	52.24	do	Do.
Island 76		40	22.36		03	24.90	do	Rept. '82.
Island 77		41	43.10		11	57.41	do	Do.
Island 80		30	46.72		12	17.70	do	Do.
Island 81		29	50.55		12	37.55	do	Do.
Island 84		18	59.08		09	25.70	do	Rept. '87.
Ivy Point		34	16.25		13	01.40	do	Rept. '82.
Jack		22	22.04		05	54.04	do	Rept. '87.

MISSISSIPPI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	33°-34°			91°-92°				
	°	′	″	°	′	″		
Kentucky Landing	33	39	46.90	91	05	42.98	Miss. R. C	Rept. '82.
Kershaw		02	01.44		08	50.00	do	Rept '87.
Leota		04	27.98		08	54.46	do	Do.
Levee		09	26.63		05	11.49	do	Do.
Meadow Point		44	53.78		08	04.88	do	Rept. '82.
Miller Bend		28	54.16		07	27.44	do	Do.
Mohawk Landing		42	51.73		03	37.01	do	Do.
Morris		29	37.74		08	20.50	do	Do.
Moss Lake		29	47.97		10	29.28	do	Do.
Mound Place		35	50.78		08	59.88	do	Do.
North base		24	19.23		03	58.77	do C. & G. S.	Do.
North Island 82		29	09.51		09	37.92	Miss. R. C	Do.
Offutt		31	04.79		11	20.36	do	Do.
Peak		58	47.54		00	28.14	do	Do.
Phillips		28	47.73		11	26.47	do	Do.
Pigeon Point		40	33.15		11	42.54	do	Do.
Port Anderson		32	14.79		11	59.37	do	Do.
Prentiss		46	37.58		04	15.29	do	Do.
Pride Point		49	32.50		02	45.10	do	Do.
Quarters		10	33.09		04	35.12	do	Rept. '87.
Randolph		26	23.23		08	00.57	do	Rept. '82.
Refuge		17	31.03		08	06.68	do	Rept. '87.
Post-office chimney		17	34.38		08	06.14	do	Do.
Oilworks, cupola		17	20.80		07	55.66	do	Do.
Richardson		21	46.29		06	30.37	do	Do.
Rock Head		39	38.01		11	01.39	do	Rept. '82.
Sand Point		27	45.79		13	14.60	do	Do.
Sedge		13	08.19		05	42.62	do	Rept. '87.
Shady Side		30	07.24		09	09.88	do	Rept. '82.
Shelby		35	47.49		11	32.11	do	Do.
House, chimney		17	44.83		08	07.95	do	Rept. '87.
Singer		42	37.47		10	27.39	do	Rept. '82.
Solona		25	48.37		07	34.70	do	Do.
South Base		23	18.19		04	32.44	do	Do.
South Island 82		27	20.47		08	11.60	do	Do.
Stella, warehouse gable		09	03.04		05	24.89	do	Rept. '87.
Stokes		56	01.30		02	06.02	do	Rept. '82.
Telegraph		09	51.84		04	32.80	do	Rept. '87.
Terrene		54	01.73		03	21.28	do	Rept. '82.
Torpley		26	54.68		07	37.91	do	Do.
Victoria		57	46.70		02	26.67	do	Do.
Walnut Point		14	08.83		06	50.71	do	Rept. '87.
Warfield		20	16.41		09	33.52	do	Do.
Waxhaw		54	52.72		02	53.36	do	Rept. '82.
Wickliffe		07	44.33		10	33.42	do	Rept. '87.
Widow		59	37.32		03	47.05	do	Rept. '82.
Wildwood		45	32.29		07	22.71	do	Do.
Williams, chimney		10	57.25		04	25.98	do	Rept. '87.
Willow Point		43	19.48		05	57.40	do	Rept. '82.
Worthington		06	24.70		10	03.48	do	Rept. '87.
Balcony		05	21.84		09	15.06	do	Do.
Wrights Point, No. 2		48	56.28		03	28.82	do	Rept. '82.
Base:	32°-33°			90°-91°				
Northeast end (delta)	32	20	01.61	90	54	53.95	do	Rept. '87.
Southwest end (delta)		19	04.60		56	13.19	do	Do.
Big Bayou		16	02.11		56	34.22	do	Do.
Charley		13	42.30		58	28.56	do	Do.
Delta:							do	Do.
Court-house, flagstaff at east end		19	06.08		56	13.41		
Engine-house cupola		19	34.43		55	30.53	do	Do.
Fort		20	26.16		53	05.04	do	Do.
Hutchinson		21	09.42		57	40.78	do	Do.
Island		21	07.11		53	41.73	do	Do.
Kemp		17	25.10		56	01.84	do	Do.
King		20	35.58		56	37.18	do	Do.
King (Mrs.), house cupola		20	37.15		56	36.86	do	Do.
McGee		23	03.23		52	57.11	do	Do.
Myer		13	44.93		57	10.77	do	Do.
New house, south gable		21	12.24		57	38.86	do	Do.
New King		20	38.82		56	46.03	do	Do.
mrall		13	00.14		58	36.07	do	Do.
Vicksburg:								
Catholic church spire		20	54.63		52	54.68	do	Do.
Court-house cupola		21	05.41		52	45.16	do	Do.
Methodist church spire		20	52.15		52	46.41	do	Do.
National cemetery flagstaff		22	25.38		52	06.45	do	Do.
Trinity church spire		20	49.18		52	49.49	do	Do.
Walnut, house chimney		18	01.69		54	32.39	do	Do.
Waddel, house, southeast chimney		21	01.60		59	19.49	do	Do.

MISSISSIPPI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
		32°-33°			90°-91°			
	°	′	″	°	′	″		
Warrenton	32	14	54.78	90	56	35.30	Miss. R. C.	Rept. '87.
Yazoo		22	07.31		59	10.54	do	Do.
		32°-33°			91°-92°			
Albemarle	32	37	14.10	91	02	00.70	do	Do.
Arcadia		39	56.17		08	25.81	do	Do.
Benham, southeast chimney		51	27.07		07	17.06	do	Do.
Ben Lomond, gin chimney		47	49.62		08	35.32	do	Do.
Big Black		06	35.45		02	34.07	do	Do.
Brunswick		34	31.83		03	51.56	do	Do.
Burleigh		37	53.84		04	05.56	do	Do.
Cabin Home		35	24.87		02	13.60	do	Do.
Cannon		08	15.19		02	33.23	do	Do.
Cordell		58	28.43		07	55.05	do	Do.
Cotton gin		37	56.93		02	59.22	do	Do.
Duncan		51	09.11		06	19.57	do	Do.
Duncannon:								
Gin chimney		50	22.44		06	18.74	do	Do.
Gin ventilator		49	43.49		06	47.56	do	Do.
Duncansby		57	47.00		05	35.65	do	Do.
Eagle		29	56.43		06	29.44	do	Do.
Elder		05	10.25		03	21.17	do	Do.
Farland		45	00.11		05	35.47	do	Do.
Gander		07	34.12		03	36.38	do	Do.
Gantt		13	02.34		00	28.53	do	Do.
Grand Gulf Island		01	34.56		04	59.75	do	Do.
Green		56	07.07		04	38.54	do	Do.
Guy		11	43.57		01	31.81	do	Do.
Gynn		34	11.08		04	34.11	do	Do.
Hall, store, west gable		43	10.68		03	49.89	do	Do.
Hankinson		12	14.84		01	42.17	do	Do.
Hays		42	42.11		04	19.86	do	Do.
Hughes		00	30.27		05	57.88	do	Do.
Ingersoll		45	57.86		06	55.75	do	Do.
Levee		25	25.23		01	15.48	do	Do.
Lewis		58	27.35		09	13.76	do	Do.
House, chimney, north end		58	30.98		09	18.28	do	Do.
Mayerville, warehouse, northeast gable.		54	00.98		03	30.48	do	Do.
Mayersville		54	20.22		04	08.53	do	Do.
McBurney		27	42.24		02	11.12	do	Do.
Melbourne, chimney		38	39.97		10	14.72	do	Do.
Montgomery, house, cupola		45	55.01		10	09.12	do	Do.
Morgan		08	52.55		00	54.77	do	Do.
No Place		37	50.46		07	59.15	do	Do.
North 95		44	41.02		04	48.80	do	Do.
Oakland, gin chimney		50	46.72		06	00.44	do	Do.
Poverty Point		59	15.82		12	28.57	do	Do.
Powell, house, southeast chimney		42	58.34		03	59.76	do	Do.
Pugh		25	05.92		00	22.92	do	Do.
Purvis		27	57.47		03	22.04	do	Do.
Richardson		59	37.09		10	44.61	do	Do.
Sand Bar		35	03.73		03	14.56	do	Do.
Sand Island		28	39.08		04	59.09	do	Do.
Sarah Island		58	19.39		11	20.24	do	Do.
Sartoris		48	01.67		08	55.08	do	Do.
Shiloh		41	49.58		05	31.27	do	Do.
Shipland		44	52.53		07	14.16	do	Do.
Shoot		38	15.41		08	37.55	do	Do.
Short		46	29.19		10	06.62	do	Do.
South 95		43	42.89		04	10.32	do	Do.
Stock Island		49	33.32		07	50.00	do	Do.
Swamp		04	39.54		04	48.38	do	Do.
Sycamore		04	39.46		06	26.06	do	Do.
Tennessee		37	50.08		06	11.00	do	Do.
Gin chimney		38	12.62		06	09.67	do	Do.
Thrasher		02	34.17		05	18.64	do	Do.
Walton, 2		13	14.99		01	09.70	do	Do.
Williams		10	28.87		00	30.25	do	Do.
Do		58	12.73		06	39.77	do	Do.
Willows		32	10.40		05	11.60	do	Do.
Winslow		47	08.44		09	06.65	do	Do.
Yucatan Bar		03	46.77		07	35.78	do	Do.
		31°-32°			91°-92°			
Allaway	31	15	43.24	91	34	18.92	do	Do.
Arnolia		33	33.14		26	41.28	do	Do.
Ashland		48	25.37		20	49.40	do	Do.
Bartlett		05	32.79		35	33.21	do	Do.
Bayou Pierre		57	54.70		08	56.12	do	Do.
Block House Hill		04	46.86		32	54.62	do	Do.
Bluff		38	43.85		23	11.93	do	Do.
Gin		01	46.63		32	50.19	do	Do.

MISSISSIPPI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	31°-32°			91°-92°				
	°	′	″	°	′	″		
Bourbon	31	23	20.03	91	28	48.51	Miss. R. C	Rept. '87.
Brenham		37	14.83		25	19.38	do	Do.
Bruinsburg		55	54.05		10	24.75	do	Do.
Buena Vista		49	04.48		19	38.29	do	Do.
Burnett		44	54.48		21	30.97	do	Do.
Butler Bluff		25	20.27		25	42.88	do	Do.
Carthage		31	59.57		27	29.54	do	Do.
Cerro Gordo		15	47.23		32	51.36	do	Do.
Gin stack		15	39.05		32	54.34	do	Do.
Clark		52	35.12		13	34.49	do	Do.
Clarksville, chimney		03	46.04		33	12.48	do	Do.
Cole Island		46	18.22		21	59.24	do	Do.
Corena		20	16.81		31	18.57	do	Do.
Gin stack		19	58.96		31	00.40	do	Do.
Deadman Bend, Government light		16	14.82		31	42.30	do	Do.
Deer Park, gin chimney		24	29.28		33	02.67	do	Do.
Duck Bar		43	02.42		23	24.65	do	Do.
Dunham Bar		36	06.13		26	26.96	do	Do.
Ellis Cliff		24	19.86		26	58.17	do	Do.
Elysian Fields		37	21.58		24	22.72	do	Do.
Fairchild		41	39.86		23	14.21	do	Do.
Faucett		37	40.79		27	09.59	do	Do.
Ferguson		19	20.55		30	59.18	do	Do.
Ford		27	30.24		30	16.29	do	Do.
Forman		50	06.46		13	48.62	do	Do.
Gaither (or Gaither, 2)		33	01.10		26	47.59	do	Do.
Gold Bottom		54	34.07		12	34.26	do	Do.
Harper		23	24.82		29	55.30	do	Do.
Hutchin Landing, Government light		24	22.32		27	09.76	do	Do.
Island		09	21.96		36	52.88	do	Do.
Ivanhoe		28	31.22		30	11.91	do	Do.
Jackson		16	02.50		35	31.66	do	Do.
Do		15	58.65		36	17 59	do	Do.
Gin		16	04.98		36	12.52	do	Do.
Kienstra		13	31.23		36	23.92	do	Do.
Chimney		13	39.34		36	23.84	do	Do.
Lower store		13	17.58		36	14.82	do	Do.
Upper store		13	33.71		36	23.59	do	Do.
Lemley		30	00.35		29	38.55	do	Do.
Leonard		23	09.30		31	44.53	do	Do.
Loch Seven		10	15.20		36	45.61	do	Do.
Gin		10	27.06		36	29.83	do	Do.
Landing		10	07.72		36	49.78	do	Do.
Lookout		33	12.15		26	41.28	do	Do.
Do		33	12.15		25	10.76	do	Do.
Minor		31	01.78		29	02.11	do	Do.
Natchez:								
Astronomical station, transit of 1878.		33	27.16		24	05.20	do	Do.
Catholic church spire cross		33	28.70		24	06.75	do	Do.
Page		25	40.84		28	47.63	do	Do.
Palmetto		21	00.15		32	00.02	do	Do.
Palo Alto (or Palo Alto, 2)		34	46.02		25	09.80	do	Do.
Peach Grove		11	35.34		35	49.78	do	Do.
Point		16	09.55		36	25.05	do	Do.
Quitman		40	37.87		22	56.52	do	Do.
Riverside, chimney		03	18.97		30	46.10	do	Do.
Rock Hill		02	09.86		33	20.32	do	Do.
Rodney		51	14.86		12	26.35	do	Do.
St. Catharine		26	13.22		29	49.03	do	Do.
Sandy Point		53	44.86		13	43.19	do	Do.
Saunders		58	40.26		08	23.30	do	Do.
Service		47	06.89		21	59.94	do	Do.
Shields		25	12.65		29	47.96	do	Do.
Government light near		25	19.17		30	16.12	do	Do.
Spithead		49	23.56		18	01.30	do	Do.
Stamp		06	49.74		36	00.20	do	Do.
Strothers		18	42.59		30	54.58	do	Do.
Surgett		24	20.02		28	48.14	do	Do.
Tarbert		00	21.38		35	59.96	do	Do.
House		01	14.69		35	20.65	do	Do.
Stable		00	57.96		35	29.52	do	Do.
Tall Pine		26	07.65		26	05.19	do	Do.
Ville		18	01.73		30	53.00	do	Do.
Walton, gin chimney		20	23.07		32	13.48	do	Do.
Waveland		58	02.29		09	43.67	do	Do.
Whitehall chute		59	56.94		07	22.34	do	Do.
Wilson		43	34.95		22	58.45	do	Do.
Winn		17	25.64		30	59.52	do	Do.
Wood yard, house chimney		16	21.25		34	30.09	do	Do.

LOUISIANA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	32°-33°			90°-91°				
	°	′	″	°	′	″		
Crane	32	20	36.30	90	57	57.10	Miss. R. C	Rept. '87.
Last		15	53.70		57	47.92	do	Do.
Mattingly		20	44.06		59	05.67	do	Do.
North Bedford		15	23.65		57	09.72	do	Do.
Reade		16	48.24		57	41.30	do	Do.
South Bedford		14	39.35		57	38.20	do	Do.
Williams		19	52.64		58	09.23	do	Do.
	32°-33°			91°-92°				
Airlie	32	37	55.65	91	09	30.28	do	Do.
Arlington		48	25.27		09	44.64	do	Do.
Ashton		59	40.32		13	00.20	do	Do.
Bass		42	53.97		04	54.08	do	Do.
Biggs		17	54.94		57	27.43	do	Do.
Broozowski (Dr.), house chimney		23	41.46		00	55.48	do	Do.
Byrne		27	09.22		04	25.47	do	Do.
Church spire		37	05.13		04	28.90	do	Do.
Concord		42	17.66		06	01.28	do	Do.
Coons		11	38.08		02	12.91	do	Do.
Cottonwood		54	06.62		05	10.95	do	Do.
Gin chimney		53	16.30		06	05.50	do	Do.
Crandall		01	44.04		05	35.00	do	Do.
Creswell		29	53.90		07	32.67	do	Do.
Deer		44	29.05		05	23.12	do	Do.
Diamond		44	21.86		06	14.23	do	Do.
Diamond Island		13	45.91		01	25.52	do	Do.
Disharoon		01	00.44		06	16.25	do	Do.
Dillon		28	53.47		07	01.71	do	Do.
Edgewood		37	08.71		07	57.08	do	Do.
Elton		50	01.32		08	42.65	do	Do.
Gin gable		50	08.90		08	59.17	do	Do.
Middle dormer window		49	58.44		09	07.30	do	Do.
Exern		43	53.73		08	27.68	do	Do.
Foster		36	01.69		03	14.00	do	Do.
Gin cupola		36	49.75		05	05.21	do	Do.
Chimney		36	57.97		05	08.19	do	Do.
Friedlander		58	54.92		13	25.38	do	Do.
Goodrich, Odd Fellows' hall, north gable.		37	41.51		00	14.05	do	Do.
Grace's store, west gable		57	35.12		04	35.22	do	Do.
Graves, house, center		27	24.31		04	34.68	do	Do.
Goza		57	58.55		12	51.92	do	Do.
Hardin		57	50.40		08	47.84	do	Do.
Hard Times		02	38.27		07	14.25	do	Do.
Henderson		35	00.07		04	12.74	do	Do.
Gin chimney		34	27.93		05	05.12	do	Do.
Hollow Ridge, church spire		51	15.68		05	48.01	do	Do.
Homestead		41	38.96		08	17.27	do	Do.
Homochitto		52	12.27		05	26.26	do	Do.
Illawana post-office, chimney		38	24.19		09	02.19	do	Do.
Imboden's store, chimney		50	28.44		13	09.57	do	Do.
Kellogg		11	06.11		01	44.75	do	Do.
Knight		00	23.85		07	52.03	do	Do.
Lake		25	58.43		02	01.88	do	Do.
Lake Providence:								
Base, north end		48	02.49		10	26.85	do	Do.
Base, south end		47	12.12		10	21.35	do	Do.
Longwood		51	30.85		07	10.50	do	Do.
Gin chimney		51	52.34		08	25.90	do	Do.
Mayer		25	24.56		02	11.02	do	Do.
McCullough's east chimney		53	10.92		05	54.92	do	Do.
Miliken's Bend, church spire		27	30.88		06	07.63	do	Do.
Moore		12	31.37		03	07.41	do	Do.
Morancy		27	56.91		06	08.45	do	Do.
Morency's house, northeast chimney		28	14.48		06	25.70	do	Do.
Munce		06	07.52		03	44.83	do	Do.
Myers's store, south chimney		37	48.80		03	00.16	do	Do.
Newman		37	01.53		03	44.87	do	Do.
Nichols		21	48.94		00	09.37	do	Do.
Old River		09	06.86		02	16.60	do	Do.
Omega		31	02.06		07	28.69	do	Do.
Owen's store, chimney		57	40.03		11	24.89	do	Do.
Pilcher's Point		57	43.94		11	25.28	do	Do.
Point Lookout		43	36.00		04	41.33	do	Do.
Point Pleasant		07	53.77		04	42.77	do	Do.
Possum Point		57	10.85		06	40.40	do	Do.
Chimney		57	05.60		06	33.24	do	Do.
Raleigh		36	56.27		05	58.39	do	Do.
River Light		55	28.31		04	14.88	do	Do.
Scott		57	41.44		06	00.48	do	Do.
Small house, west gable		55	27.65		04	14.52	do	Do.
Stamboul		40	31.33		09	54.43	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	32°–33°			91°–92°				
	°	′	″	°	′	″		
Terrapin	32	32	58.21	91	06	01.35	Miss. R. C	Rept. '87.
Utz		23	03.09		00	58.41	do	Do.
Villa Vista		34	13.50		05	22.02	do	Do.
Vista		52	37.63		06	15.04	do	Do.
Gin chimney		52	11.34		06	53.72	do	Do.
Wilkinson		10	21.81		01	20.27	do	Do.
Wilson		03	46.77		07	35.78	do	Do.
Wilson's Point		56	03.14		05	20.33	do	Do.
Gin chimney		55	42.84		05	26.80	do	Do.
Wilton		39	24.57		10	23.39	do	Do.
Wyly		45	24.16		10	06.91	do	Do.
Wyly's house, east gable		45	23.44		10	26.13	do	Do.
	31°–32°			91°–92°				
Ashley	31	25	48.00	91	31	15.46	do	Do.
Gin chimney		26	11.13		31	29.94	do	Do.
(Below) Government light		24	33.86		31	05.13	do	Do.
Ballamagan		06	46.76		36	45.05	do	Do.
Black Hawk		09	23.57		37	34.04	do	Do.
Gin		09	32.43		37	50.68	do	Do.
Bondurant		56	33.20		11	03.84	do	Do.
Bougere		16	42.70		36	58.09	do	Do.
Chimney		16	44.87		36	53.99	do	Do.
Gin		16	48.41		36	53.20	do	Do.
Bullock		37	33.69		28	57.89	do	Do.
Cabin		15	32.76		38	12.69	do	Do.
Canebrake		42	00.20		24	09.95	do	Do.
Connor		37	51.44		25	35.93	do	Do.
Conti		30	14.55		30	31.04	do	Do.
Coochee		05	42.17		36	23.84	do	Do.
Crothers		28	26.02		31	44.18	do	Do.
House chimney		28	47.63		31	01.03	do	Do.
(North of) smokestack		28	43.86		31	08.80	do	Do.
(Near) ginhouse stack		28	10.96		31	21.33	do	Do.
(North of) belfry		28	42.74		31	10.38	do	Do.
CXI Bar		50	28.38		14	19.93	do	Do.
Davis		39	46.75		23	37.62	do	Do.
Down-river, dovecot		28	46.92		30	58.17	do	Do.
Esperance		25	00.35		28	47.88	do	Do.
Fairview		24	27.65		31	54.01	do	Do.
Fairview Landing, river front of new store.		19	49.76		31	51.22	do	Do.
Fritz		16	58.51		31	52.29	do	Do.
Gillespie		55	14.20		12	53.00	do	Do.
Glasscock		21	00.48		33	37.95	do	Do.
Golman		48	55.29		21	18.77	do	Do.
Goodhope		38	17.82		27	20.68	do	Do.
Hard Scrabble		58	50.95		09	02.30	do	Do.
Harpers Island		50	31.62		16	01.82	do	Do.
Hole in Wall		43	13.71		24	09.46	do	Do.
Home Place		16	19.66		33	47.93	do	Do.
Store gable		16	22.29		33	48.08	do	Do.
Kemps Landing		49	47.47		19	44.54	do	Do.
Kers Point		00	49.32		36	47.88	do	Do.
Langside:								
Chimney		01	58.56		34	44.22	do	Do.
Gin		01	46.27		34	40.29	do	Do.
L'Argent		44	28.46		23	42.49	do	Do.
Lees Point		51	06.88		13	15.05	do	Do.
Lewis		52	24.36		14	22.01	do	Do.
Lum		02	52.85		34	44.81	do	Do.
Lums Point, base:								
Southwest end, astronomical station.		02	29.11		35	17.08	do	Do.
Northeast end		03	13.73		34	26.42	do	Do.
McElroy		16	10.43		31	43.27	do	Do.
Moro		29	10.85		30	40.38	do	Do.
Natchez		31	25.99		30	20.20	do	Do.
Natchez Island, Government light		30	14.07		30	30.86	do	Do.
Obers		18	49.54		31	42.21	do	Do.
Gin chimney		18	28.02		32	26.78	do	Do.
Pecan		14	54.47		38	04.35	do	Do.
Do		24	21.73		30	30.91	do	Do.
Point Breeze		04	15.82		33	45.78	do	Do.
Pullen		09	56.98		37	33.25	do	Do.
Race course		45	59.34		22	44.55	do	Do.
Roseland		20	05.55		32	21.10	do	Do.
Gin chimney		19	27.26		31	50.03	do	Do.
Rosenthal		22	48.93		34	11.85	do	Do.
Store, river end		23	51.54		33	24.82	do	Do.
St. Joseph		54	04.73		14	20.91	do	Do.
Shamrock		40	30.20		23	44.48	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	31°-32°			91°-92°				
	°	′	″	°	′	″		
Tower	31	13	04.87	91	37	35.91	Miss. R. C	Rept. '87.
Tregar		00	15.26		37	32.29	do	Do.
Union Point		13	33.23		37	07.33	do	Do.
Gin		12	51.92		37	43.16	do	Do.
Up-river, dovecot		28	47.87		30	57.94	do	Do.
Vancluse		33	43.86		23	55.90	do	Do.
Vidalia:								
West end base		36	04.48		26	24.01	do	Do.
Do		35	01.02		26	24.01	do	Do.
East end base		33	42.59		25	18.00	do	Do.
Warnicott		27	15.89		31	15.25	do	Do.
(Near) gin chimney		27	09.40		31	40.96	do	Do.
Waterloo, 2		36	19.80		28	41.39	do	Do.
Waterproof		48	06.39		22	56.59	do	Do.
Watson		55	42.60		11	58.96	do	Do.
Whitehall		32	23.44		28	31.19	do	Do.
Wilds		16	30.18		35	07.85	do	Do.
	30°-31°			90°-91°				
Anderson	30	04	09.38	90	54	48.47	do	Do
Sugarhouse chimney		08	31.15		55	04.63	do	Do.
Ashland, sugarhouse chimney		10	59.90		59	14.96	do	Do.
Bowden		09	39.47		59	40.71	do	Do
Sugarhouse chimney		09	36.64		59	01.07	do	Do.
Brand, sugarhouse chimney		06	00.47		54	05.02	do	Do.
Brulé, sugarhouse chimney		08	31.54		53	15.42	do	Do.
Burnside		09	52.19		55	55.82	do	Do.
Clark pump chimney		08	12.41		55	25.68	do	Do.
Cofield, sugarhouse chimney		07	53.23		55	58.42	do	Do.
Colomb, bagasse burner		04	30.60		50	46.33	do	Do.
Conway, sugarhouse chimney		09	10.86		54	41.79	do	Do.
Donaldson, sugarhouse chimney		09	03.97		55	58.42	do	Do.
Donaldsonville:								
Baptist church		06	11.54		59	18.79	do	Do.
Methodist church		06	15.28		59	25.48	do	Do.
Cross on convent		06	14.36		59	05.47	do	Do.
Cupola of Lemann's block		06	25.81		59	13.37	do	Do.
Catholic church, east tower		06	18.05		58	58.25	do	Do.
Base, north end		06	11.22		57	54.89	do	Do.
Base, south end		04	23.90		58	10.57	do	Do.
Dugas, sugarhouse, east chimney		05	55.55		58	11.01	do	Do.
Garnier, bagasse burner		03	23.15		52	32.56	do	Do.
Hampton		05	12.13		53	07.46	do	Do.
Hermitage, sugarhouse chimney		06	59.43		57	48.23	do	Do.
Houmas, sugarhouse chimney		07	27.27		54	26.23	do	Do.
Ice factory, chimney		06	16.71		58	30.70	do	Do.
Lauderdal, sugarhouse chimney		04	28.03		55	10.87	do	Do.
Leblanc:								
Bagasse burner		04	59.64		55	41.57	do	Do.
Sugarhouse, south chimney		07	46.75		59	34.41	do	Do.
Lemann		06	30.61		55	39.23	do	Do.
Sugarhouse chimney		05	49.57		59	01.67	do	Do.
Minlor, sugarhouse chimney		04	47.63		52	02.99	do	Do.
Nelmo		57	51.60		15	25.67	do	Do.
New Hope, sugarhouse chimney		03	24.54		53	01.37	do	Do.
Orange Grove, sugarhouse chimney		08	50.20		53	54.00	do	Do.
Rapidan, sugarhouse chimney		04	38.26		52	24.02	do	Do.
Riverton		08	37.55		57	21.76	do	Do.
Sugarhouse chimney		08	57.16		56	51.38	do	Do.
St. Ann's chapel		09	06.78		59	42.17	do	Do.
St. Mary's, church cross		05	17.96		54	17.33	do	Do.
St. Victoria, bagasse burner		03	15.69		54	17.09	do	Do.
Salsbury, sugarhouse chimney		05	19.42		55	20.60	do	Do.
Scanlon, sugarhouse chimney		06	12.30		54	09.49	do	Do.
Stella, sugarhouse chimney		05	37.09		57	29.10	do	Do.
Tureaud		07	35.43		54	10.85	do	Do.
Texas		10	26.44		58	16.78	do	Do.
Trist, sugarhouse chimney		04	30.21		53	01.65	do	Do.
Union, sugarhouse chimney		06	40.08		54	14.94	do	Do.
Wallace, sugarhouse chimney		05	39.89		57	58.33	do	Do.
Whitehall, sugarhouse chimney		04	42.21		53	37.38	do	Do.
Winchester, sugarhouse chimney		03	03.34		54	51.18	do	Do.
	30°-31°			91°-92°				
Acklin	30	56	05.52	91	38	10.81	do	Do.
Adelard Landry, sugarhouse chimney.		10	02.25		00	48.96	do	Do.
Alexander Creek		45	28.23		22	22.78	do	Do.
Do		45	34.69		22	19.99	do	Do.
Allsworth		31	27.02		11	53.21	do	Do.
Anchorage		28	56.53		12	01.00	do	Do.
Sugarhouse chimney		29	00.32		12	19.57	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	30°-31°			91°-92°				
	°	′	″	°	′	″		
Anger	30	17	26.38	91	10	03.83	Miss. R. C	Rept. '87.
Angola		57	31.14		39	01.92	do	Do.
Arizona, sugarhouse:								
South chimney		13	16.99		05	03.88	do	Do.
North chimney		13	17.46		05	04.02	do	Do.
Arlington		23	47.41		12	49.12	do	Do.
Ashland, flagstaff		10	23.72		00	07.84	do	Do.
Australia		20	09.88		09	36.29	do	Do.
Sugarhouse chimney		19	57.03		09	30.35	do	Do.
Ayraud		05	44.77		02	27.88	do	Do.
Babina, sugarhouse chimney		29	48.08		15	36.50	do	Do.
Bagatelle, sugarhouse chimney		14	32.32		06	22.29	do	Do.
Bailey		19	22.87		11	09.83	do	Do.
Bar		30	54.46		16	25.59	do	Do.
Barrow		36	01.63		19	10.26	do	Do.
Barrow's chimney		47	39.47		31	31.60	do	Do.
Baton Rouge		26	19.00		11	26.42	do	Do.
Barracks, flagstaff		27	23.45		11	17.33	do	Do.
Astronomical and longitudinal station.		27	18.02		11	17.86	do	Do.
Barracks, astronomical azimuth station.		27	28.35		11	24.43	do	Do.
Methodist church spire		27	05.76		11	11.56	do	Do.
North end base		25	59.92		11	24.72	do	Do.
South end base		25	09.43		11	42.15	do	Do.
State penitentiary, round brick chimney.		27	04.21		10	55.59	do	Do.
State House, northwest tower		26	51.56		11	20.29	do	Do.
State University, pole on cupola		26	28.70		11	07.86	do	Do.
Batture		17	06.00		12	09.05	do	Do.
Bayou		28	28.01		11	31.79	do	Do.
Bayou Sara:								
Methodist church		46	08.34		23	40.59	do	Do.
Schoolhouse		46	04.52		23	28.22	do	Do.
Vane		45	58.17		23	35.43	do	Do.
Gin chimney		45	59.68		23	23.57	do	Do.
Colored church belfry		44	30.99		22	13.59	do	Do.
Belair		30	33.81		12	07.55	do	Do.
Sugarhouse, west chimney		30	29.34		12	25.29	do	Do.
Belle Vale		30	15.85		14	57.85	do	Do.
Belle Vale, sugarhouse chimney		30	15.11		14	50.12	do	Do.
Belle Grove		11	22.14		07	11.89	do	Do.
Sugarhouse chimney		11	06.52		06	55.59	do	Do.
Store, east gable		11	21.67		07	11.85	do	Do.
Belmont		30	40.21		14	02.45	do	Do.
Belmont, sugarhouse chimney		29	59.54		14	10.47	do	Do.
Bend		19	26.44		09	37.69	do	Do.
Bergeron		43	44.63		33	42.09	do	Do.
Big Cave		39	50.81		19	08.36	do	Do.
Bockel		44	32.88		27	12.90	do	Do.
Brulé Landing church		23	09.92		14	09.27	do	Do.
Bougeoir		47	15.11		32	24.97	do	Do.
Gin		46	42.34		35	31.13	do	Do.
Boulieu		25	19.51		12	39.53	do	Do.
Sugarhouse chimney		25	28.09		12	49.23	do	Do.
Bovard		45	06.40		23	58.07	do	Do.
House		45	01.58		23	42.73	do	Do.
Sugarhouse chimney		44	52.52		13	52.06	do	Do.
Brandon		50	59.61		31	07.40	do	Do.
Brown		36	26.05		18	08.19	do	Do.
Stable		36	36.95		17	49.82	do	Do.
Burnside, bagasse burner		08	34.94		02	02.71	do	Do.
Canty sawmill chimney		07	39.98		01	31.59	do	Do.
Cat Island		44	26.68		33	57.44	do	Do.
Celeste, sugarhouse chimney		11	29.94		06	19.47	do	Do.
Chamberlain		28	36.84		12	39.84	do	Do.
Do		32	09.03		17	30.01	do	Do.
Chataw, sugarhouse chimney		11	24.09		03	37.71	do	Do.
Chatworth		20	41.01		09	02.23	do	Do.
Sugarhouse chimney		20	53.56		08	36.12	do	Do.
Cheatham		55	19.37		36	09.66	do	Do.
Chinn		31	20.65		17	28.83	do	Do.
Church, near Evergreen		16	29.16		11	54.45	do	Do.
Cinclare		23	45.79		13	36.63	do	Do.
Stable lightning rod		23	49.57		13	52.33	do	Do.
Claiborne		11	58.70		04	12.19	do	Do.
Sugarhouse chimney		43	47.36		27	36.87	do	Do.
Do		11	50.01		04	33.92	do	Do.
Clark, sugarhouse chimney		33	14.51		17	28.76	do	Do.
Clarke		33	57.99		15	42.41	do	Do.
Clement		15	59.78		09	47.90	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	30°-31°			91°-92°				
	°	′	″	°	′	″		
Coal yard	30	31	05.84	91	14	09.49	Miss. R. C	Rept. '87.
House		55	00.87		34	01.68	do	Do.
Colwell		30	33.06		16	28.16	do	Do.
Sugarhouse chimney		30	24.88		16	17.06	do	Do.
Como		54	30.08		31	53.17	do	Do.
Conrad		18	47.15		11	14.38	do	Do.
Cottage		21	15.31		13	24.29	do	Do.
Sugarhouse chimney		21	26.96		13	37.93	do	Do.
Cotton		49	07.71		31	51.78	do	Do.
Coulon		44	51.94		25	04.25	do	Do.
Crescent		05	17.78		00	20.80	do	Do.
Sugarhouse chimney		04	39.01		01	17.43	do	Do.
Cuba, sugarhouse chimney		11	04.48		02	05.35	do	Do.
Cut Off		55	32.44		37	10.20	do	Do.
Depot, astronomical station		45	52.73		23	18.45	do	Do.
Deserted Cabin		52	40.63		31	14.78	do	Do.
Devall		32	52.58		15	53.62	do	Do.
Dichary		08	23.93		00	31.02	do	Do.
Sugarhouse chimney		08	21.56		00	11.37	do	Do.
Douglas		51	19.84		31	42.77	do	Do.
Doyle's chimney		45	21.07		22	12.68	do	Do.
Duncan		22	07.16		13	55.90	do	Do.
Dupuy		14	42.93		06	42.57	do	Do.
Eastman		58	28.86		38	37.93	do	Do.
Elevator		40	19.62		17	21.84	do	Do.
Evan Hall		07	31.81		02	36.88	do	Do.
Sawmill chimney		07	18.64		02	08.51	do	Do.
Sugarhouse chimney		07	02.28		02	52.87	do	Do.
Evergreen		16	28.82		11	56.98	do	Do.
Fancy Point		40	33.13		19	53.08	do	Do.
Fairot		29	56.62		13	16.57	do	Do.
Ferry		27	10.10		12	01.52	do	Do.
Fisher		44	37.29		31	39.82	do	Do.
Fischer's Landing		47	18.95		34	54.17	do	Do.
Forlorn Hope, sugarhouse chimney		17	24.21		09	25.67	do	Do.
Fort		44	46.30		21	44.36	do	Do.
Frances Gomez, sugarhouse chimney		05	33.27		01	31.75	do	Do.
Gay		16	41.86		12	44.49	do	Do.
Gay's house, lightning rod		26	57.53		12	05.83	do	Do.
Gem, sugarhouse chimney		08	42.08		00	02.69	do	Do.
Glennon		35	16.58		18	48.99	do	Do.
Sugarhouse chimney		34	52.92		19	06.32	do	Do.
Golden Ridge		15	54.89		07	40.50	do	Do.
Gravel		35	30.46		18	06.96	do	Do.
Greenfield, sugarhouse chimney		16	01.09		10	15.40	do	Do.
Hard Times		31	13.33		12	32.88	do	Do.
Sugarhouse chimney		13	15.64		05	13.91	do	Do.
Hereford, sugarhouse chimney		34	16.74		18	27.54	do	Do.
Hicky		20	45.69		14	33.64	do	Do.
Hill		28	26.16		12	00.77	do	Do.
Hog Point		55	36.15		38	42.01	do	Do.
Hog Point Landing		55	50.73		39	00.81	do	Do.
Hollywood, bagasse chimney		21	15.40		10	38.58	do	Do.
Home Place, sugarhouse chimney		09	26.63		00	42.41	do	Do.
Hopkins		43	50.92		30	04.69	do	Do.
Horner		31	22.65		13	21.13	do	Do.
Indian Camp, sugarhouse chimney		11	52.54		07	29.41	do	Do.
Iron chimney		16	04.30		10	40.64	do	Do.
Keller		47	52.99		31	21.61	do	Do.
Kelson		36	45.92		18	44.59	do	Do.
Sugarhouse chimney		37	24.48		18	53.07	do	Do.
Kingsbury		57	27.87		39	45.24	do	Do.
Store		57	24.57		39	46.00	do	Do.
Knox		29	17.00		11	35.75	do	Do.
Labry		42	43.71		21	14.69	do	Do.
Last		34	42.00		16	00.57	do	Do.
Leblanc		07	15.14		00	14.10	do	Do.
Lebret		42	50.09		20	43.24	do	Do.
Leonard		45	12.47		34	55.45	do	Do.
Leperre, sugarhouse chimney		20	28.83		13	11.89	do	Do.
Letherman		54	35.69		33	05.17	do	Do.
Levert		15	52.79		07	23.58	do	Do.
Lieux sawmill		41	31.87		21	05.07	do	Do.
Light-house:								
(Near Chatworth)		20	24.40		08	36.98	do	Do.
(Near Hicky, removed April, 1880)		20	56.19		14	35.79	do	Do.
(Near Woodland)		18	26.28		13	55.02	do	Do.
Limerick		26	09.88		12	12.40	do	Do.
Sugarhouse, north chimney		26	07.17		12	21.85	do	Do.
Sugarhouse, south chimney		26	06.64		12	21.91	do	Do.
Lobdell		34	35.90		17	52.48	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	30°-31°			91°-92°				
	°	′	″	°	′	″		
Long Wood	30	39	57.43	91	18	28.22	Miss. R. C	Rept. '87.
Lopez		21	02.41		11	36.36	do	Do.
McCallum's Point		44	10.05		35	46.40	do	Do.
McManner:								
Sawmill chimney		07	44.23		02	11.55	do	Do.
Sugarhouse chimney		07	42.49		02	40.30	do	Do.
McWilliams house lightning rod		19	08.34		12	33.79	do	Do.
Magee		45	50.00		24	09.77	do	Do.
Manchac		18	59.06		08	51.13	do	Do.
Sugarhouse chimney		18	42.30		08	23.10	do	Do.
Martin		20	21.73		12	11.45	do	Do.
Maryland		12	33.13		06	15.49	do	Do.
Medora		19	07.26		12	35.95	do	Do.
Miles chimney		55	16.66		38	21.88	do	Do.
Miles Point		55	12.25		37	29.08	do	Do.
Missouri		22	19.99		14	33.54	do	Do.
Modeste, sugarhouse chimney		10	23.42		01	07.85	do	Do.
Monte Sano		30	38.62		11	35.42	do	Do.
Monticello		15	38.53		06	25.64	do	Do.
Morganza		44	11.35		34	46.12	do	Do.
Morrison, sugarhouse chimney		43	28.40		31	37.67	do	Do.
Mount Houmas, sugarhouse chimney		12	11.88		00	41.51	do	Do.
Mount Houmas house, south gable		11	44.14		01	12.85	do	Do.
Mount Pleasant		38	14.70		17	52.34	do	Do.
Stable		38	33.40		17	30.79	do	Do.
Landing		38	32.16		17	45.62	do	Do.
Gin		38	33.64		17	38.13	do	Do.
Mulberry Grove, sugarhouse chimney		21	15.55		09	54.95	do	Do.
Neal		46	33.43		34	41.99	do	Do.
Negro church or school		35	14.20		18	59.80	do	Do.
New House		47	21.04		31	47.90	do	Do.
New Texas		46	54.01		35	13.49	do	Do.
Gin chimney		46	13.00		35	34.22	do	Do.
Chimney		46	10.77		35	38.08	do	Do.
Flagstaff		46	28.15		35	28.61	do	Do.
Quitman statue		46	26.20		35	25.66	do	Do.
Nina, sugarhouse chimney		40	57.64		21	04.74	do	Do.
Oaks, sugarhouse, south chimney		26	50.13		12	19.40	do	Do.
Ober gin		46	28.13		35	35.80	do	Do.
Ohlivalla, sugarhouse chimney		10	41.37		07	35.26	do	Do.
Old Hickory, sugarhouse chimney		11	53.94		05	22.71	do	Do.
Old River		54	48.88		36	29.97	do	Do.
Old River House		54	48.63		36	36.54	do	Do.
One Hundred Mile, sugarhouse chimney.		14	28.77		06	36.08	do	Do.
Ophelia		13	04.60		08	08.43	do	Do.
Palo Alto		14	10.26		08	04.73	do	Do.
Sugarhouse chimney		05	37.30		02	23.93	do	Do.
Pederre overseer's house		43	43.58		28	53.75	do	Do.
Pelico, sugarhouse chimney		09	07.75		01	19.13	do	Do.
Plaquemine		17	17.12		13	36.61	do	Do.
Catholic church spire		17	31.97		14	02.85	do	Do.
Point		31	24.19		16	50.51	do	Do.
Do		18	05.54		13	24.99	do	Do.
Point Coupee base:								
Southeast end		44	49.20		22	35.00	do	Do.
Do		44	55.65		22	32.22	do	Do.
Northwest end		45	08.63		23	24.08	do	Do.
Point Pleasant		15	22.95		06	51.73	do	Do.
Pole		27	17.86		11	23.43	do	Do.
Poplar		29	21.20		13	52.09	do	Do.
Poplar Grove, sugarhouse chimney		29	26.77		12	24.08	do	Do.
Porche		43	10.87		21	21.56	do	Do.
Port Hudson		40	27.00		17	54.10	do	Do.
Sawmill		40	36.66		17	20.56	do	Do.
Port Manoir		39	50.66		17	58.96	do	Do.
Powell		44	05.82		21	21.56	do	Do.
Proctor chimney		54	47.88		36	07.07	do	Do.
Profit Island		34	56.93		17	50.14	do	Do.
Raccourci Point		47	58.12		32	00.93	do	Do.
Ralston		35	24.70		27	06.86	do	Do.
Randolph, sugarhouse chimney		35	24.28		19	16.57	do	Do.
Red River		58	50.26		39	08.54	do	Do.
School		58	11.06		39	58.86	do	Do.
Light		58	35.32		39	26.16	do	Do.
Warehouse		58	00.20		39	50.16	do	Do.
Red Store		44	03.49		27	00.30	do	Do.
Rescue		12	58.45		04	35.72	do	Do.
Sugarhouse chimney		13	10.88		04	28.91	do	Do.
Revenue, sugarhouse chimney		13	32.40		03	58.18	do	Do.
Rews Ditch		47	41.24		33	44.22	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	30°-31°			91°-92°				
	°	′	″	°	′	″		
Reynaud	30	34	17.51	91	16	05.28	Miss. R. C	Rept. '87.
Rifle Point		37	58.53		24	58.77	do	Do.
Riley		34	57.47		16	49.10	do	Do.
Riverlight		12	57.41		04	47.57	do	Do.
Rivers		23	39.08		33	19.45	do	Do.
Gin chimney		24	30.72		33	36.30	do	Do.
R. O. Landry, sugarhouse chimney		08	56.24		01	36.25	do	Do.
Rome		06	46.50		00	56.81	do	Do.
Rouzan, sugarhouse chimney		20	30.97		08	05.19	do	Do.
Rowe		55	30.09		34	04.47	do	Do.
St. Bernard		55	03.43		34	09.18	do	Do.
St. Francis church		44	52.08		24	56.27	do	Do.
St. Francisville:								
Catholic church cross		46	26.82		23	25.55	do	Do.
Episcopal church		46	32.40		23	14.55	do	Do.
St. Gabriel church		15	19.86		06	24.33	do	Do.
St. Martin		09	15.71		02	03.15	do	Do.
St. Maurice		43	44.87		28	42.96	do	Do.
St. Peter's and St. Paul's church		30	16.74		15	11.93	do	Do.
Sandy Point		40	13.41		19	16.45	do	Do.
School		14	53.98		07	14.93	do	Do.
Schultz		47	12.33		33	36.52	do	Do.
Shaw		47	37.58		32	38.51	do	Do.
Shelton		41	32.96		20	30.05	do	Do.
Slaughter		39	56.26		17	23.56	do	Do.
Small house, chimney		18	48.66		09	19.62	do	Do.
Smith chimney		55	52.05		39	03.62	do	Do.
Smithland gin		55	44.87		39	06.17	do	Do.
Solitude		34	29.05		16	50.45	do	Do.
Southwood		13	26.81		03	04.90	do	Do.
Sugarhouse chimney		13	19.56		02	54.08	do	Do.
Souvenir, sugarhouse chimney		06	45.94		01	51.94	do	Do.
Springfield		33	54.83		15	02.51	do	Do.
Star, sugarhouse chimney		14	49 26		06	25.28	do	Do.
Stevenson		52	32.03		31	41.39	do	Do.
Stewart, sugarhouse chimney		43	43.50		31	55.75	do	Do.
Stump		53	59.06		32	25.84	do	Do.
Swamp		30	56.46		14	56.65	do	Do.
Taylor		43	39.89		21	33.21	do	Do.
Sugarhouse chimney		44	04.34		22	02.19	do	Do.
Thomas		32	31.95		15	36.48	do	Do.
Thompson		44	31.96		22	04.28	do	Do.
Tonliet, sugarhouse chimney		20	25.26		11	44.48	do	Do.
Tregars chimney		59	27.59		38	40.74	do	Do
Tunica Island		49	18.49		31	14.57	do	Do.
Tunica Landing		55	15.19		33	01.72	do	Do.
Van Winkle		40	02.06		20	23.82	do	Do.
Van Winkle B. B		39	20.57		20	43.16	do	Do.
Ventress		16	50.81		08	24.25	do	Do.
Vignes		45	10.06		35	26.43	do	Do.
Sugarhouse chimney		42	25.00		21	25.10	do	Do.
Viola		31	02.33		13	10.14	do	Do.
Vohn's, sugarhouse chimney		24	20.19		13	35.33	do	Do.
Von Pool		29	25.04		12	02.07	do	Do.
Wade		52	39.77		31	13.56	do	Do.
House		52	57.11		31	19.58	do	Do.
Shed		52	27.49		31	07.38	do	Do.
Waterloo		41	18.99		20	57.75	do	Do.
Church		40	48.87		21	40.44	do	Do.
Sugarhouse chimney		12	42.28		01	19.16	do	Do.
Store		41	50.56		21	08.12	do	Do.
Wick's, sugarhouse chimney		25	32.16		11	03.26	do	Do.
Wild Wood		38	18.60		18	21.21	do	Do.
Sawmill		38	15.63		18	25.75	do	Do.
Willow Bar		45	20.07		25	21.34	do	Do.
Willow Glen		16	14.30		07	02.23	do	Do.
Winter		32	04.12		16	30.43	do	Do.
Sugarhouse chimney		36	43.60		19	02.95	do	Do.
Woodland		18	25.28		13	58.40	do	Do.
Woods		20	24.97		10	49.80	do	Do.
Woodstock, sugarhouse chimney		10	28.12		01	20.51	do	Do.
Woodyard		44	12.22		28	47.20	do	Do.
Yale, sugarhouse chimney		10	46.66		01	47.86	do	Do.
	29°-30°			90°-91°				
Caillon	29	05	41.59	90	31	41.30	C. & G. S	
Calumet		06	12.59		20	58.79	do	
George		06	33.82		15	09.27	do	
James		06	22.18		24	11.10	do	
Tape		08	43.01		31	33.49	do	
Terrebonne		06	30.08		28	19.86	do	
Timballier light-house (1887)		03	06.01		20	57.38	do	

TEXAS.

Name.	Latitude.	Longitude.	Authority.	Reference.
	33°-34°	99°-100°		
	° ′ ″	° ′ ″		
ell	33 09 31.57	99 43 54.96	G. S	Bull. 122.
son	00 56.10	59 34.60	do	Do.
	3°3-34°	100°-101°		
	33 03 59.68	100 26 11.37	do	Do.
	32°-33°	96°-97°		
den	32 40 47.93	96 54 56.48	do	Do.
th	51 44.85	46 23.42	do	Do.
	47 19.39	39 49.01	do	Do.
	32°-33°	97°-98°		
s	32 55 12.22	97 16 38.17	do	Do.
ne	07 32.51	46 44.20	do	Do.
	15 11.92	16 57.74	do	Do.
s	39 48.57	43 43.31	do	Do.
Peak	29 00.39	24 27.05	do	Do.
pede	36 32.51	12 07.25	do	Do.
nche	22 38.19	47 59.00	do	Do.
u	09 36.80	59 24.87	do	Do.
e	53 44.08	06 34.46	do	Do.
rood	06 04.59	40 45.05	do	Do.
ngs	10 16.44	14 28.25	do	Do.
son	48 18.01	53 38.28	do	Do.
	19 09.35	32 52.02	do	Do.
	03 43.68	20 01.32	do	Do.
ly	01 16.18	42 49.30	do	Do.
	53 50.54	42 36.74	do	Do.
r	09 10.70	51 03.25	do	Do.
	20 07.12	36 41.29	do	Do.
l	43 17.38	07 59.43	do	Do.
ak	41 45.52	16 30.30	do	Do.
snake	48 05.84	38 32.84	do	Do.
wn	56 44.38	54 39.80	do	Do.
r	09 58.97	05 58.61	do	Do.
w	26 17.43	01 24.99	do	Do.
	32°-33°	98°-99°		
Jack	32 57 15.29	98 51 18.72	do	Do.
	55 35.49	18 02.09	do	Do.
s	54 29.77	30 09.01	do	Do.
nridge	48 03.95	49 51.89	do	Do.
	22 04.81	56 19.87	do	Do.
tronomical pier	23 31.45	58 55.56	do	Do.
and	39 12.25	41 26.88	do	Do.
	43 47.07	17 52.54	do	Do.
Mountain	35 06.69	55 05.25	do	Do.
ie	19 19.02	22 38.75	do	Do.
	41 51.43	27 25.52	do	Do.
on	17 40.67	29 27.79	do	Do.
	49 24.60	19 08.23	do	Do.
	02 41.87	54 53.40	do	Do.
ny	27 09.30	11 22.81	do	Do.
iel	17 09.56	49 47.97	do	Do.
y	18 32.64	13 19.65	do	Do.
	12 58.07	21 36.91	do	Do.
an	40 59.96	35 58.02	do	Do.
	32°-33°	99°-100°		
e	32 26 51.39	99 44 39.80	do	Do.
	45 29.54	53 43.83	do	Do.
	19 07.47	52 08.98	do	Do.
	36 00.71	29 11.90	do	Do.
wood	13 41.10	09 10.76	do	Do.
	10 21.65	49 45.86	do	Do.
ase	39 17.06	11 56.21	do	Do.
p	51 20.75	05 39.68	do	Do.
	28 42.69	18 50.74	do	Do.
	59 33.38	10 19.31	do	Do.
	12 01.65	56 43.69	do	Do.
	44 20.15	18 48.62	do	Do.
	15 26.24	40 48.20	do	Do.
	50 51.24	24 09.62	do	Do.
	47 28.06	12 14.84	do	Do.
	42 15.90	52 40.50	do	Do.
t	42 44.26	25 11.16	do	Do.
ap	01 23.63	46 54.52	do	Do.
ula	58 20.32	34 21.57	do	Do.
	27 43.99	01 26.22	do	Do.
	32°-33°	100°-101°		
	32 43 49.63	100 06 19.79	do	Do.
	00 40.36	27 34.69	do	Do.
	19 55.64	16 37.66	do	Do.

TEXAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	32°-33°			100°-101°				
	°	′	″	°	′	″		
Fence	32	26	40.88	100	14	30.05	G. S	Bull. 122.
Flint		07	48.41		02	41.19	do	Do.
Goat		00	56.09		36	27.63	do	Do.
Rusticus		12	39.04		15	12.15	do	Do.
Sweetwater		28	31.23		24	24.09	do	Do.
Sykes		17	29.43		23	42.72	do	Do.
Wasp		34	11.27		26	36.08	do	Do.
Jacksonville:	31°-32°			95°-96°				
Astronomical station	31	57	49.70	95	16	16.80	C. & G. S.	
Methodist spire		57	37.91		16	20.03	do	
Presbyterian spire		57	40.47		16	07.57	do	
	31°-32°			97°-98°				
Adams	31	53	31.39	97	43	23.58	G. S	Do.
Doty		56	23.59		51	41.64	do	Do.
Frazier		59	31.22		04	44.75	do	Do.
Ghent		19	18.01		19	08.22	do	Do.
Kellum		48	45.07		27	16.61	do	Do.
Kendrick		29	37.62		14	18.50	do	Do.
Lynch		12	29.66		20	19.08	do	Do.
Mount Taylor		04	54.52		57	45.14	do	Do.
Nick		43	19.10		28	53.50	do	Do.
Simpson		36	08.95		29	26.69	do	Do.
West		48	22.07		05	47.56	do	Do.
Wind Mill		26	01.94		30	02.20	do	Do.
	31°-32°			98°-99°				
Station D	31	04	09.80	98	39	45.30	do	Do.
Thompson		55	13.70		53	40.90	do	Do.
Waters Mountain		05	31.20		20	27.60	do	Do.
	31°-32°			99°-100°				
Ballinger	31	44	24.92	99	56	40.24	do	Do.
Bones		00	31.31		39	17.61	do	Do.
Bradley		48	43.66		41	25.84	do	Do.
Live Oak		17	15.82		39	28.17	do	Do.
Maddox		04	19.66		46	12.14	do	Do.
Molloy		17	20.35		51	21.63	do	Do.
Mustang		02	34.52		56	00.35	do	Do.
Plateau		37	41.66		55	39.75	do	Do.
Rough		55	20.70		36	44.93	do	Do.
	31°-32°			100°-101°				
Ashurst	31	48	42.42	100	40	01.30	do	Do.
Bolt		08	19.11		50	47.98	do	Do.
Cedar		45	18.85		19	36.94	do	Do.
Concho		47	19.71		49	10.33	do	Do.
Dove		11	49.51		37	33.05	do	Do.
Dry		34	21.54		53	50.27	do	Do.
Edith		53	37.40		39	52.57	do	Do.
Flower		05	35.80		05	09.43	do	Do.
Funk		31	20.22		48	47.32	do	Do.
Gunny		30	03.10		38	58.62	do	Do.
Hayrick		59	29.96		20	48.70	do	Do.
Keith		11	54.22		13	44.55	do	Do.
Lake		52	13.50		46	01.34	do	Do.
Lipan		14	17.14		19	20.68	do	Do.
Lopez		20	40.27		51	04.44	do	Do.
Napp		46	37.47		43	00.86	do	Do.
Robert Lee		53	39.29		29	03.87	do	Do.
San Angelo		27	51.31		26	16.06	do	Do.
Water Valley		37	47.51		45	15.85	do	Do.
	31°-32°			104°-105°				
Diablo	31	11	50.54	104	54	52.40	do	Do.
El Capitan		53	26.38		51	39.69	do	Do.
	31°-32°			105°-106°				
Arispe	31	09	11.33	105	17	00.09	do	Bull. 70.
Cerro Alto		56	39.90		58	15.05	do	Bull. 122.
East base		04	54.70		09	32.38	do	Bull. 70.
Mesa		07	16.43		09	12.38	do	Do.
Quitman		08	56.68		29	48.26	do	Bull. 122.
Salt		34	40.74		08	51.69	do	Do.
Sierra Blanca		15	05.34		26	09.64	do	Do.
Astronomical pier		10	27.64		21	24.96	do	Bull. 70.
Taff		12	28.86		17	25.68	do	Do.
West base		06	35.65		13	03.41	do	Do.
Yucca		06	40.08		20	51.72	do	Do.
	31°-32°			106°-107°				
El Paso, Fort Bliss, astronomical monument.	31	45	31.00	106	29	05.00	Wheeler	Rept. '79.
Graveyard Hill		45	52.00		29	41.00	do	Do.

TEXAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	31°-32°			106°-107°				
	°	′	″	°	′	″		
th Franklin	31	54	07.24	106	29	35.83	G. S	Bull. 122.
th Franklin Mountain		48	15.00		28	47.00	Wheeler	Rept. '79.
	30°-31°			97°-98°				
l Knob	30	20	05.87	97	35	23.54	G. S	Bull. 122.
rop Hill		07	38.30		18	35.80	do	Do.
rer Hill		42	25.88		33	52.51	do	Do.
ar Hill		11	21.78		57	08.14	do	Do.
Hill		47	16.87		37	15.18	do	Do.
y Ratlif		53	41.15		43	52.40	do	Do.
stack		35	02.56		41	00.60	do	Do.
		11	48.84		36	32.72	do	Do.
l office		16	19.93		44	13.02	do	Do.
Tree, 1		19	17.54		48	29.95	do	Do.
rison Ridge		45	19.74		50	42.37	do	Do.
Knob		09	29.83		42	20.80	do	Do.
N		27	15.59		42	07.64	do	Do.
rie, 2		51	14.17		57	33.71	do	Do.
s Hill		08	35.36		32	09.60	do	Do.
base		12	15.17		42	56.82	do	Do.
a Knob		20	31.99		11	20.30	do	Do.
	30°-31°			98°-99°				
elor Peak	30	59	39.33	98	05	42.00	do	Do.
Mountain		26	47.45		43	00.12	do	Do.
linghouse		33	37.40		05	19.93	do	Do.
ter Hill		56	22.45		17	33.60	do	Do.
e Mountain		35	33.74		55	08.09	do	Do.
Man		04	35.92		05	11.12	do	Do.
Mountain		53	52.98		20	09.43	do	Do.
Mountain		40	07.12		36	18.32	do	Do.
r Hill		46	17.52		16	11.78	do	Do.
d		27	11.52		21	57.88	do	Do.
le		18	12.80		05	38.58	do	Do.
el		26	30.19		14	46.10	do	Do.
on B		54	38.67		52	43.77	do	Do.
on E		13	40.14		26	32.70	do	Do.
	30°-31°			100°-101°				
	30	49	00.64	100	18	24.99	do	Do.
nk		47	08.23		04	54.00	do	Do.
s		48	55.20		55	40.18	do	Do.
r		39	40.12		07	33.92	do	Do.
		43	24.69		58	22.66	do	Do.
		18	24.18		17	28.67	do	Do.
		05	08.67		15	50.98	do	Do.
		54	07.25		05	59.39	do	Do.
McKavett		49	44.07		08	30.69	do	Do.
		10	05.90		10	47.16	do	Do.
		00	26.69		14	16.28	do	Do.
all		21	42.64		12	08.09	do	Do.
son		25	35.59		02	23.80	do	Do.
		45	21.64		41	42.07	do	Do.
		32	52.64		12	28.28	do	Do.
		38	41.06		14	59.28	do	Do.
		51	35.49		46	26.47	do	Do.
		43	14.84		48	53.68	do	Do.
		16	00.83		27	18.40	do	Do.
vorth		26	34.59		20	38.55	do	Do.
		03	41.97		21	55.55	do	Do.
	30°-31°			103°-104°				
Ord	30	14	23.04	103	30	56.05	do	Do.
		46	36.32		47	40.23	do	Do.
	30°-31°			104°-105°				
	30	38	05.85	104	10	26.27	do	Do.
		48	07.73		42	36.10	do	Do.
an signal		59	51.56		59	56.49	do	Bull. 70.
an		59	58.36		04	45.31	do	Bull. 122.
		27	07.33		40	42.70	do	Do.
	30°-31°			105°-106°				
	30	55	14.41	105	05	08.13	do	Do.
	29°-30°			98°-99°				
isters	29	58	48.70	98	26	40.50	do	Do.
	29°-30°			100°-101°				
cho	29	11	12.82	100	17	10.78	do	Do.
		12	07.36		08	28.00	do	Do.
		46	21.43		28	11.65	do	Do.
lark		18	27.65		25	08.14	do	Do.
		44	56.80		17	24.28	do	Do.
v		54	15.25		19	01.08	do	Do.

TEXAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	29°-30°			100°-101°				
	°	′	″	°	′	″		
Las Moras	29	21	31.62	100	23	13.43	G. S	Bull. 122.
Monte		33	46.53		12	02.84	do	Do.
Nueces		37	33.84		19	51.26	do	Do.
Reagan		44	56.45		11	27.54	do	Do.
Spofford, water tank		10	31.91		24	32.72	do	Do.
Turkey		22	30.25		11	55.82	do	Do.
	29°-30°			103°-104°				
San Jacinto	29	45	12.59	103	57	19.11	do	Do.
Santiago		50	04.66		24	59.26	do	Do.
	29°-30°			104°-105°				
Chinati	29	57	09.32	104	28	41.05	do	Do.

ARKANSAS.

Name.	Latitude.			Longitude.			Authority.	Reference.
	36°-37°			91°-92°				
	°	′	″	°	′	″		
Salem	36	22	33.15	91	51	51.75	G. S	Bull. 122.
	36°-37°			92°-93°				
Alpha	36	13	01.65	92	06	48.75	do	Do.
Matny		12	18.70		18	57.43	do	Do.
Pilot		05	33.37		01	19.18	do	Do.
Pine, 2		24	47.43		40	42.55	do	Do.
Wallace Knob		21	23.63		22	37.71	do	Do.
	36°-37°			93°-94°				
Boat	36	07	33.17	93	02	09.29	do	Do.
Bread		34	45.63		28	47.28	do	Do.
Kennedy		14	24.06		13	31.11	do	Do.
Lead		25	50.96		00	52.38	do	Do.
Pyron		23	35.29		32	08.61	do	Do.
Sugar		27	36.37		53	48.00	do	Do.
Swain		17	23.38		45	52.65	do	Do.
Watson		15	00.09		28	21.56	do	Do.
	36°-37°			94°-95°				
Kestler	36	01	00.91	94	13	11.84	do	Do.
Orchard		09	59.74		04	32.59	do	Do.
Rogers		19	53.30		06	43.29	do	Do.
Twin		08	42.54		22	42.02	do	Do.
	35°-36°			90°-91°				
Appersen	35	06	51.50	90	10	07.14	Miss. R. C	Rept. '88.
Collins		01	32.71		17	33.87	do	Do.
East base		08	26.40		09	11.98	do	Do.
Fleece		03	11.19		10	11.52	do	Do.
Harris		02	13.13		12	47.81	do	Do.
Jones		05	25.92		10	33.06	do	Do.
Mathews		04	00.11		10	51.94	do	Do.
Mound City		10	39.88		06	29.73	do	Do.
Reeves		03	04.37		11	35.77	do	Do.
Scanlon		02	08.14		16	14.26	do	Do.
West base		08	09.59		10	36.53	do	Do.
	35°-36°			91°-92°				
Cedar	35	56	30.75	91	49	24.90	G. S	Bull. 122.
Deane		44	34.43		44	24.55	do	Do.
Mount Etna		52	32.89		45	07.36	do	Do.
	35°-36°			92°-93°				
Black	35	32	43.48	92	40	47.05	do	Do.
Blue		52	14.86		21	51.18	do	Do.
Brush		49	03.11		36	52.05	do	Do.
Burrow		09	31.11		43	28.65	do	Do.
Cox		03	50.10		14	56.57	do	Do.
Evans		29	25.31		51	19.02	do	Do.
Finch		46	32.23		10	42.94	do	Do.
Fourche		01	01.68		50	55.13	do	Do.
Hump		20	23.13		13	17.40	do	Do.
Irons Point		51	30.69		01	04.50	do	Do.
Pig		17	40.98		32	22.09	do	Do.
Pine Hill		38	06.80		41	20.52	do	Do.
Point Pisgah		07	29.37		29	16.62	do	Do.
Pond		41	32.08		11	27.52	do	Do.
Raspberry		39	42.80		57	49.34	do	Do.
Red Hill		43	30.27		30	59.57	do	Do.
Reeves		43	31.74		44	17.74	do	Do.
Round, 2		50	26.51		56	23.41	do	Do.
Walker		40	13.08		51	46.06	do	Do.
Walnut		39	06.44		30	30.06	do	Do

ARKANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	35°–36°			93°–94°				
	°	′	″	°	′	″		
nker Hill	35	03	10.25	93	19	48.41	G. S	Bull. 122.
bbs		54	04.07		59	28.90	do	Do.
agazine		09	57.68		38	41.72	do	Do.
ring		12	42.00		19	36.80	do	Do.
	35°–36°			94°–95°				
ston	35	47	37.74	94	10	03.95	do	Do.
ne Hill		54	32.67		27	53.07	do	Do.
rtright		42	00.22		08	46.89	do	Do.
ake		57	41.53		31	16.56	do	Do.
rt Smith		23	14.65		25	52.35	do	Do.
e		37	42.12		21	58.45	do	Do.
ckard		39	37.70		15	09.63	do	Do.
ak		04	22.98		22	22.85	do	Do.
nacle		12	45.51		03	12.44	do	Do.
ylight		50	02.13		32	30.28	do	Do.
ane		51	26.29		09	14.99	do	Do.
ickler		47	44.26		20	16.53	do	Do.
kefield		44	14.02		02	28.69	do	Do.
	34°–35°			90°–91°				
bison	34	22	41.73	90	41	46.12	do	Do.
ams		34	13.68		33	58.61	Miss. R. C	
erson		19	22.63		44	32.04	G. S	Do.
en		12	51.70		54	08.13	do	Do.
uckle		20	12.28		44	57.00	do	Do.
ley		45	48.88		26	53.09	Miss. R. C	Rept. '87.
dwin		47	08.52		27	26.50	do	Do.
ket		51	10.55		23	54.75	do	Do.
h Point		05	30.72		55	07.37	do	Rept. '82.
ry		39	30.58		30	51.23	do	Rept. '87.
e Point		50	19.13		25	45.71	do	Do.
k Oak		01	34.13		03	23.82	do	Rept. '82.
deaux Island		45	48.85		30	22.77	do	Rept. '87.
kshot		35	32.69		33	15.48	do	Rept. '82.
tnett		03	12.58		54	13.97	do	Do.
ile		23	17.62		43	15.05	do	Do.
Island		55	31.59		15	55.39	do	Rept. '87.
Chute		57	17.51		16	04.78	do	Do.
k		45	09.20		27	39.33	do	Do.
g		24	19.19		37	30.66	do	Rept. '82.
te of 70		00	44.10		57	52.10	do	Do.
e Landing		15	05.59		53	45.14	do	Do.
view		59	11.84		17	37.76	do	Rept. '87.
orite Chute		44	56.19		31	12.88	do	Do.
Penny		23	21.61		38	22.27	do	Rept. '82.
ler		07	29.61		56	53.18	do	Do.
m		13	39.39		55	28.03	do	Do.
ldys		01	05.73		02	09.50	do	Do.
dler		51	35.65		20	20.91	do	Rept. '87.
l Luck		02	44.85		55	39.03	do	Rept. '82.
lim Point		40	13.21		29	11.78	do	Rept. '87.
na		31	06.06		35	15.09	do	Rept. '82.
na Island No. 2		34	40.65		32	21.91	do	Do.
ier		36	31.37		35	10.09	do	Rept. '87.
ney		16	09.25		48	57.54	do	Rept. '82.
d 62		18	09.59		45	22.38	do	Do.
d 63		17	30.48		45	39.10	do	Do.
d 67		08	56.54		57	11.68	do	Do.
d 68		08	30.47		56	30.04	do	Do.
		11	10.44		52	52.80	do	Do.
son		40	25.02		33	30.04	do	Rept. '88.
aroo Point		22	16.17		40	17.72	do	Rept. '82.
lton		09	50.51		54	09.39	do	Do.
nia		02	20.86		56	25.74	do	Do.
		38	50.76		35	08.41	do	Rept. '88.
ow		11	32.62		54	28.03	do	Rept. '82.
y		14	49.02		50	09.87	do	Do.
rk		06	29.50		56	13.29	do	Do.
wk		09	16.51		52	12.17	do	Do.
c		17	28.13		47	52.86	do	Do.
llom		20	53.26		45	20.01	do	Do.
nnell		57	58.73		16	28.55	do	Rept. '88.
r		09	28.04		50	58.24	do	Rept. '82.
quet		17	48.95		46	35.64	do	Do.
s		48	47.25		27	42.03	do	Rept. '88.
r Lake		52	08.18		19	17.04	do	Do.
le		35	37.18		34	04.13	do	Do.
itt		21	50.94		45	18.85	do	Rept. '82.
		27	29.65		34	52.57	do	Do.
rs		43	45.82		31	50.45	do	Rept. '88.

ARKANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	34°-35°			90°-91°				
	°	′	″	°	′	″		
St. Francis	34	40	00.08	90	31	43.53	Miss. R. C	Rept. '83.
St. Louis Landing		11	18.35		51	49.80	do	Rept. '82.
Sterling		37	27.75		35	34.87	do	Rept. '83.
Tow Head		17	59.77		44	19.60	do	Rept. '82.
West base		39	10.54		32	25.40	do	Rept. '83.
Westover		22	55.12		39	15.24	do	Rept. '82.
Walnut Bend		42	52.44		31	23.23	do	Rept. '83.
Wardell		39	24.73		28	59.63	do	Do.
Warfield		01	52.15		57	09.66	do	Rept. '82.
Williamson		29	32.87		35	27.48	do	Do
Zenor		09	54.94		56	19.41	do	Do.
	34°-35°			91°-92°				
Foot of 70	34	00	10.06	91	00	49.71	do	Do.
Henley		00	44.49		04	41.36	do	Do.
Scrub Grass		00	17.90		03	46.25	do	Do.
	34°-35°			92°-93°				
Big Rock	34	46	17.88	92	17	55.49	G. S	Bull. 122.
Blocher		40	12.75		50	32.26	do	Do.
East base		44	09.15		10	24.73	do	Do.
Granite		41	11.10		17	30.50	do	Do.
Maumelle		50	25.22		29	09.79	do	Do.
Moss Mountain		49	53.56		40	43.42	do	Do.
Post-office		44	47.83		16	25.36	do	Do.
Reynolds		58	28.95		28	17.66	do	Do.
Shinall		47	51.69		29	49.62	do	Do.
West base		45	19.09		13	33.32	do	Do.
Warsaw		56	33.48		08	52.12	do	Do.
	34°-35°			93°-94°				
Allen	34	51	06.10	93	28	14.79	do	Do.
Muddy		46	06.63		31	57.82	do	Do.
Powell		46	01.91		20	45.57	do	Do.
Round		44	00.72		44	55.63	do	Do.
Smith		46	11.34		01	49.01	do	Do.
Whiteoak		58	41.14		56	41.10	do	Do.
	34°-35°			94°-95°				
Black Fork	34	42	39.78	94	22	05.39	do	Do.
Blue		41	07.21		02	53.18	do	Do.
East Poteau		58	32.51		09	30.16	do	Do.
Poteau, 2		57	42.39		22	31.33	do	Do.
	33°-34°			91°-92°				
Adams	33	12	35.70	91	06	03.33	Miss. R. C	Rept. '83.
Arkansas River		48	41.21		04	22.02	do	Rept. '82.
Arkansas City		36	06.49		12	31.35	do	Do.
Bachelors Bend, tow-head		23	35.23		05	34.93	do	Rept. '83.
Barnard		05	54.40		10	35.21	do	Do.
Betaley		59	01.89		04	09.20	do	Rept. '82.
Bradley		57	22.66		03	09.49	do	Do.
Brooks		09	09.00		09	28.35	do	Rept. '83.
Cane		43	35.28		10	56.80	do	Rept. '82.
Cassell		59	49.91		04	52.14	do	Do.
Catfish Tow-head		40	41.36		08	30.06	do	Do.
Chicora		40	28.00		12	24.65	do	Do.
Chicot		38	55.47		10	58.84	do	Do.
Cook		40	25.69		05	04.81	do	Do.
Coryes		42	27.28		04	45.30	do	Do.
Cracraft's gin, southeast gable		03	50.50		09	45.19	do	Do.
Cumbyville		54	07.09		08	57.62	do	Do.
Cypress Creek		43	13.16		11	48.85	do	Do.
Davis		18	55.89		11	00.65	do	Do.
Deadwood		43	12.05		06	55.94	do	Do.
Drift		10	27.90		05	26.45	do	Rept. '83.
Duffin		35	24.94		13	20.47	do	Rept. '83.
Eunic		32	23.38		12	45.58	do	Do.
Frank, J		53	14.11		03	52.27	do	Do.
Ford		08	49.85		07	53.74	do	Rept. '83.
Gaines Landing		27	51.90		14	28.68	do	Rept. '82.
Good Luck		43	10.75		09	31.84	do	Do.
Goose Bar		15	21.19		07	40.25	do	Rept. '83.
Graves		00	58.81		09	53.22	do	Do.
Store, northeast chimney		02	16.91		09	42.48	do	Do.
Haley		08	25.73		11	08.73	do	Do.
Halliday		22	26.22		07	48.58	do	Do.
Harwood		09	18.91		06	37.96	do	Do.
Harwood's store, chimney		09	39.42		06	11.70	do	Do.
Harwood, white house, southeast chimney.		09	40.42		06	28.32	do	Do.
Hawkins		09	48.23		06	05.91	do	Do.
Hayden		42	42.45		05	53.93	do	Rept. '82.
Hill's chimney		07	49.20		08	44.99	do	Rept. '83.

ARKANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	33°-34°			91°-92°				
	°	′	″	°	′	″		
Hilliard	33	04	54.70	91	10	05.42	Miss. R. C	Rept. '88.
Hilliard's pigeon house		04	50.91		10	06.37	do	Do.
Hilliard's store chimney		04	52.10		10	06.00	do	Do.
Hunting Lodge		08	15.94		09	48.94	do	Do.
Island 78		36	46.27		09	44.39	do	Rept. '82.
Island 83		25	20.40		08	58.47	do	Do.
Jersey Point		40	57.39		07	15.36	do	Do.
Junction		13	20.01		07	00.70	do	Rept. '88.
Lakeport		13	37.43		07	31.09	do	Do.
Lands End		59	15.90		00	17.07	do	Rept. '82.
Leland		21	41.85		09	09.44	do	Do.
Longwood:								
Gin chimney		09	26.64		04	37.49	do	Rept. '88.
Warehouse gable		09	15.33		05	18.64	do	Do.
Marengo, gin chimney		05	54.88		11	29.23	do	Do.
Middle Ground		50	05.95		08	28.32	do	Rept. '82.
Melona		51	29.22		08	07.89	do	Do.
Mitchell		39	41.08		11	46.10	do	Do.
Montgomery		58	06.02		08	32.66	do	Do.
Moore		07	32.10		11	51.06	do	Rept. '88.
Mud Creek		28	38.13		14	17.93	do	Rept. '82.
Napoleon		47	45.35		04	33.45	do	Do.
North Choctaw		38	20.50		09	56.12	do	Do.
Oak Landing		44	08.01		08	29.53	do	Do.
Old Town		22	55.91		44	25.92	do	Do.
Ozart		45	56.60		06.	32.98	do	Do.
Palmetto		33	16.62		13	24.13	do	Do.
Panther Forest		26	47.53		12	28.68	do	Do.
Point Chicot		24	44.14		05	24.84	do	Rept. '88.
Tow Head		26	04.00		05	06.98	do	Rept. '82.
Point Comfort		28	40.47		10	40.46	do	Do.
Point Cook		41	29.00		03	53.80	do	Do.
Raft		11	42.42		05	34.81	do	Rept. '88.
Raynor		03	59.84		09	34.36	do	Do.
Rowdy Bend		26	50.95		13	41.37	do	Rept. '82.
Russett		42	00.01		02	53.33	do	Do.
Sabenden		41	20.95		12	38.08	do	Do.
Sibley		56	25.35		03	00.68	do	Do.
Scott		27	29.08		11	23.08	do	Do.
South Choctaw		37	21.02		09	19.52	do	Do.
Starling		16	46.24		08	29.68	do	Rept. '88.
Sterling		02	02.89		09	36.32	do	Do.
Stevenson		00	09.42		11	05.68	do	Do.
Sunnyside		17	31.73		09	22.35	do	Do.
Thorn Point		46	38.45		05	20.47	do	Rept. '82.
Turner		40	17.03		06	17.35	do	Do.
Vancluse		20	27.64		10	32.78	do	Rept. '88.
Wallwood		25	37.56		00	35.10	do	Rept. '82.
Warner		28	37.54		08	04.30	do	Do.
White Hill		36	24.25		11	19.67	do	Do.
White River		55	31.36		03	19.12	do	Do.
Whittaker		22	57.68		06	47.74	do	Rept. '88.
Wilkinson		42	09.15		08	10.34	do	Rept. '82.
Williams		45	15.51		08	37.61	do	Do.
Yellow Bend		34	16.41		13	46.24	do	Do.

INDIAN TERRITORY.

	35°-36°			94°-95°				
	°	′	″	°	′	″		
Cavanal	35	04	11.43	94	40	46.16	G. S	Bull. 122.
North base		07	59.47		32	01.88	do	Do.
Poteau, 1		55	24.14		29	28.19	do	Do.
South base		05	47.52		33	23.98	do	Do.
Sugarloaf		01	31.49		28	07.04	do	Do.

TENNESSEE.

	36°-37°			82°-83°				
	°	′	″	°	′	″		
Bristol	36	35	49.00	82	11	13.00	C. & G. S	Bull. 122.
Chimney Top		24	28.90		42	24.20	G. S	
Holston		27	27.30		04	38.50	do	Do.
Roan		08	16.40		07	20.60	do	Do.

TENNESSEE—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	36°-37°			83°-84°				
	°	′	″	°	′	″		
House	36	06	42.90	83	45	59.90	G. S	Bull. 122.
McLean		28	19.80		55	47.50	do	Do.
Short		22	52.60		10	45.80	do	Do.
War Gap		30	14.70		01	38.00	do	Do.
	36°-37°			84°-85°				
Adkins	36	09	42.75	84	51	52.98	C. & G. S	
Brushy		04	37.22		24	37.75	do	
Cross		11	55.20		13	52.30	do	Do.
Jellico		35	03.20		07	28.80	do	
	36°-37°			85°-86°				
Apple	36	10	48.51	85	48	09.98	do	
Walker		10	26.85		20	36.63	do	
	35°-36°			82°-83°				
Chucky	35	59	39.50	82	53	42.30	G. S	Do.
	35°-36°			83°-84°				
Chilhowee, 1	35	45	54.50	83	45	30.10	do	Do.
English		54	04.90		17	51.50	C. & G. S	Do.
	35°-36°			84°-85°				
Hangover	35	23	11.70	84	58	08.16	do	
Chilhowee, 2		35	46.90		00	28.00	G. S	Do.
Chilhowee, 4		07	24.70		37	16.20	do	Do.
Guide		26	25.80		14	03.60	do	Do.
Hinch		46	53.10		58	42.80	do	Do.
Luper		57	16.39		47	20.17	do	
Melton		54	34.80		18	18.40	do	Do.
Owen		36	34.00		29	38.84	do	
Roy		31	27.60		26	46.30	G. S	Do.
Texas		19	31.70		54	38.40	do	Do.
	35°-36°			85°-86°				
Cardwell	35	40	59.82	85	40	47.61	C. & G. S	
Grindstone		04	18.00		01	18.60	G. S	Do.
Harvey		23	33.10		17	44.90	do	Do.
Mount Love		54	57.71		32	26.12	C. & G. S	
Short		52	14.78		58	22.44	do	Do.
	35°-36°			86°-87°				
Bennett	35	55	57.47	86	37	11.08	do	
Versailles		43	11.94		32	22.52	do	
	35°-36°			90°-91°				
Barton	35	12	16.53	90	06	03.23	Miss. R. C	Rept. '87.
Bayou		08	05.49		07	38.44	do	Do.
Cow Island		00	19.18		16	57.76	do	Do.
Bend		00	12.26		17	56.78	do	Do.
Crawford		06	54.00		08	23.68	do	Do.
Davis		07	05.13		06	46.91	do	Do.
Ensley		04	10.88		09	39.29	do	Do.
Forrest		06	41.10		05	20.86	do	Do.
Frame Chute		10	57.76		04	14.43	do	Do.
Hopefield		09	54.98		04	27.02	do	Do.
Horn Lake		01	19.59		12	30.17	do	Do.
Lake		07	41.73		09	18.49	do	Do.
Leadbetter		06	08.40		09	31.28	do	Do.
Memphis		08	39.00		03	15.45	C. & G. S	Rept. '84.
Do		08	39.85		03	20.22	Miss. R. C	Rept. '87.
Do		08	38.60		03	16.50	L. S	Final Rept.
Do		08	37.50		03	17.40	do	Do.
Patterson		02	09.75		13	52.91	Miss. R. C	Rept. '87.
Peterson		07	46.06		04	15.11	do	Do.
Rock Chute		01	29.67		13	52.91	do	Do.
Vance, jr		07	39.56		05	37.57	do	Do.
Vance, sr		08	30.58		04	26.90	do	Do.
Wolf River		10	06.18		03	19.66	do	Do.
Watson		01	54.65		11	17.84	do	Do.

KENTUCKY.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			82°-83°				
	°	′	″	°	′	″		
Howland	38	37	47.18	82	59	20.14	C. & G. S	Rept. '84.
Louisa transit		06	54.90		36	06.15	do	Do.
Buena Vista		23	44.10		48	21.47	do	
Oakland		21	46.55		38	52.70	do	
	38°-39°			83°-84°				
Cave	38	32	39.81	83	04	23.42	do	
Mount Sterling		03	28.40		55	50.90	G. S	Bull. 122.

KENTUCKY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			84°-85°				
	°	′	″	°	′	″		
Falmouth	38	40	37.60	84	16	54.20	C. & G. S	
Lexington College building		02	25.30		30	21.00	do	
	38°-39°			85°-86°				
Cox Knob	38	09	25.40	85	46	15.80	do	
Louisville		15	08.00		45	28.80	do	
Shelbyville		12	45.40		13	14.60	do	
	37°-38°			82°-83°				
Frazier	37	24	02.90	82	40	05.60	G. S	Bull. 122.
Preston		46	57.30		55	11.60	do	Do.
Quicksand		29	03.30		55	46.20	do	Do.
Wasioto		06	44.80		43	54.00	do	Do.
Willard		15	35.30		22	59.90	do	Do.
Wolf		43	34.40		34	20.90	do	Do.
	37°-38°			83°-84°				
Ballard	37	55	18.40	83	42	23.10	do	Do.
Carr		14	29.20		05	33.50	do	Do.
Coburn		55	56.20		43	43.90	do	Do.
Cope		37	26.90		18	51.00	do	Do.
Gross		30	31.10		35	32.40	do	Do.
High Rocks		47	22.80		46	38.70	do	Do.
Hunter		23	10.00		46	20.60	do	Do.
High Knob		14	57.60		53	49.70	do	Do.
Hogtown		37	01.90		04	28.30	do	Do.
Nailor		27	49.50		24	58.00	do	Do.
Nelson		43	18.40		31	05.10	do	Do.
Orchard		08	35.20		44	05.80	do	Do.
Pilot		12	53.80		50	05.60	do	Do.
Raccoon		09	04.30		50	29.60	do	Do.
Rice		22	14.30		35	33.90	do	Do.
Rose		27	39.70		33	16.30	do	Do.
Turkey		27	16.30		44	26.80	do	Do.
Willoughby		55	39.80		53	07.60	do	Do.
	37°-38°			84°-85°				
Bear	37	32	08.90	84	15	21.30	do	Do.
Brushy		20	04.50		25	51.20	do	Do.
Green River		09	14.90		50	42.50	do	Do.
Lancaster		37	10.50		34	43.30	do	Do.
London		08	02.20		05	20.14	C. & G. S	Rept. '84.
Richmond		44	30.40		18	02.64	G. S	Bull. 122.
Central College		44	32.80		18	02.00	C. & G. S	
Sand		31	12.40		52	08.90	G. S	Do.
Stone quarry		37	56.20		02	33.10	do	Do.
	37°-38°			85°-86°				
Greensburg	37	15	33.30	85	29	56.40	C. & G. S	
	37°-38°			86°-87°				
Oakland	37	02	27.50	86	15	18.20	do	Rept. '84.
	37°-38°			87°-88°				
Henderson	37	50	24.80	87	35	26.10	do	Do.
	37°-38°			88°-89°				
Paducah	37	04	59.20	88	35	56.10	do	Do.
	36°-37°			83°-84°				
Gray Knob	36	47	16.20	83	17	26.40	G. S	Bull. 122.
Harlan		53	54.70		19	03.10	do	Do.
Longspur		56	22.40		02	30.50	do	Do.
Paint Gap		57	16.50		36	31.80	do	Do.
White Rocks		39	54.70		27	03.30	do	Do.
	36°-37°			84°-85°				
King	36	50	59.90	84	05	34.40	do	Do.
	36°-37°			87°-88°				
Guthrie	36	38	53.90	87	09	36.15	C. & G. S	
	36°-37°			89°-90°				
Hickman	36	34	17.70	89	11	40.35	do	Rept. '84.

OHIO.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			80°-81°				
	°	′	″	°	′	″		
Andover	41	37	05.72	80	36	30.62	L. S	Final Rept.
Ashtabula:								
Baptist church		52	02.70		47	01.60	do	Do.
Southwest corner passenger depot		52	38.13		47	38.55	do	Do.

OHIO—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	°	′	″	°	′	″		
	41°-42°			80°-81°				
Conneaut	41	53	52.58	80	36	51.56	C. & G. S.	Final Rept.
Geneva		51	14.20		59	47.00	do	Do.
Saybrook		53	33.00		49	55.00	do	Do.
Mesopotamia		26	59.98		59	54.09	do	Do.
Berea:	41°-42°			81°-82°				
German Wallace College chapel spire.	41	22	06.10	81	51	06.30	do	Do.
Stone Methodist church spire		21	46.70		51	12.50	do	Do.
Chester		32	02.88		21	17.20	do	Do.
Claridon		30	39.61		07	06.27	do	Do.
Cleveland:								
Light-house on high bank in city		30	06.13		42	13.20	do	Do.
Light-house		30	01.60		42	09.60	do	Do.
Euclid		35	37.30		33	05.20	do	Do.
Fairport:								
Light-house on bank		45	24.80		16	39.70	do	Do.
Light-house on pier		45	41.60		16	48.80	do	Do.
Grafton		12	44.21		59	37.85	do	Do.
Little Mountain		38	26.34		16	28.60	do	Do.
North Royalton:								
Stone Baptist church spire		18	53.60		44	10.70	do	Do.
Frame Methodist church, in northern part of town, spire.		19	29.20		44	10.40	do	Do.
Olmstead		22	52.18		57	22.98	do	Do.
Painesville:								
Episcopal church (spire) on west side of State street.		43	41.20		14	36.10	do	Do.
Spire brick Congregational church		43	26.00		14	44.30	do	Do.
Perry		48	04.70		08	55.60	do	Do.
Rockport		27	45.98		47	32.30	do	Do.
Royalton		19	29.89		44	10.65	do	Do.
Thompson		41	14.35		02	37.47	do	Do.
Warrensville		28	39.24		30	12.88	do	Do.
Willoughby		40	28.71		26	25.77	do	Do.
	41°-42°			82°-83°				
Black River light-house	41	28	23.90	82	11	08.30	do	Do.
Brownhelm		23	18.46		18	28.76	do	Do.
Camden		16	26.04		17	46.73	do	Do.
Cedar Point light-house		29	17.40		41	37.40	do	Do.
Danbury		31	11.94		50	20.30	do	Do.
East base		26	28.58		38	04.66	do	Do.
Elyria		24	55.41		08	44.06	do	Do.
Green Island light-house		38	43.90		52	04.10	do	Do.
Huron:								
Presbyterian church spire		23	42.60		33	21.00	do	Do.
Light-house		24	03.10		32	51.10	do	Do.
Kelley		36	17.77		41	45.29	do	Do.
Marblehead light-house		32	11.00		42	43.40	do	Do.
Middle base		41	47.87		47	15.12	do	Do.
Oberlin:								
Second Congregational church spire.		17	28.90		13	10.50	do	Do.
Pointed tower at Union School building, South Main street.		17	26.20		13	01.80	do	Do.
Point Pelee		48	50.72		41	02.55	do	Do.
Sandusky		24	34.43		45	02.76	do	Do.
Court-house		27	13.80		42	41.90	do	Do.
Townsend		15	43.48		29	00.63	do	Do.
Vermillion		25	12.70		21	59.40	do	Do.
West base		29	02.32		40	58.43	do	Do.
	41°-42°			83°-84°				
Cedar Point	41	42	37.77	83	20	06.66	do	Do.
Locust Point		36	54.83		06	21.38	do	Do.
Toledo:								
St. Mary's Catholic church spire		39	32.10		32	02.50	do	Do.
Astronomical station, 182 west and 188 north of stone marking intersection of Ontario and Monroe streets; stone, long post, of 1881.		39	03.65		32	30.60	do	Do.
Turtle Island light-house		45	08.80		23	28.80	do	Do.
West Sister Island light-house		44	13.10		06	39.00	do	Do.
	39°-40°			82°-83°				
Columbus, transit	39	57	40.00	82	59	42.15	C. & G. S.	Rept. '84.
	39°-40°			84°-85°				
Cincinnati	39	08	20.00	84	25	20.49	do	Do.
Mitchell's observatory (abandoned).		05	54.00		29	45.75	do	Do.

OHIO—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			82°-83°				
	°	′	″	°	′	″		
Fradd	38	35	47.00	82	33	05.85	C. & G. S	Bull. 122.
Gould		38	27.64		49	56.46	do	Do.
South Point		25	14.00		35	26.00	do	Do.
Wray		35	42.32		27	38.71	do	Do.

INDIANA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			84°-85°				
	°	′	″	°	′	″		
Fremont	41	42	32.09	84	57	58.97	L. S	Final Rept.
NW. corner sec. 31, T. 38 N., R. 14 E		42	55.90		58	16.00	do	Do.
	41°-42°			85°-86°				
Corner secs. 2, 3, 10, 11, T. 37 N., R. 6 E	41	40	54.80	85	48	43.50	do	Do.
Jefferson		41	00.04		48	30.08	do	Do.
SW. corner NW. ¼ sec. 33, T. 38 N., R. 8 E.		42	16.10		37	13.60	do	Do.
Corner secs. 4, 5, 8, 9, T. 37 N., R. 11 E		41	08.40		16	23.30	do	Do.
Lima, tower schoolhouse		43	30.70		25	13.60	do	Do.
Mongo		41	34.56		16	08.70	do	Do.
Van Buren		42	29.79		36	46.74	do	Do.
	41°-42°			86°-87°				
Carlisle	41	40	05.16	86	29	38.80	do	Do.
Galena		41	45.88		40	32.13	do	Do.
Michigan City		44	07.79		52	20.79	do	Do.
High school spire		42	51.80		53	47.60	do	Do.
Spire Lutheran church		42	45.40		53	59.60	do	Do.
Light-house		43	21.10		54	21.80	do	Do.
Otis		35	18.65		52	35.94	do	Do.
Penn		38	53.13		12	26.72	do	Do.
New Carlisle:								
Spire Christian church		42	22.30		30	41.90	do	Do.
Spire Methodist Episcopal church		42	25.70		30	40.80	do	Do.
South Bend:								
Standpipe		40	31.40		14	52.60	do	Do.
University dome		42	11.00		14	20.90	do	Do.
Springville		39	52.80		44	30.61	do	Do.
Corner secs. 17, 18, 19, 20, T. 37 N., R. 3 E		39	04.40		12	57.30	do	Do.
Corner secs. 2, 3, 10, 11, T. 37 N., R. 1 W		40	46.40		30	23.60	do	Do.
SW. corner SE. ¼ of SW. ¼ sec. 32, T. 38 N., R. 2 W.		41	39.00		40	33.40	do	Do.
SE. corner sec. 10, T. 37 N., R. 3 W		39	52.20		44	19.70	do	Do.
NW. corner sec. 10, T. 36 N., R. 4 W		35	32.80		52	39.00	do	Do.
	41°-42°			87°-88°				
Miller	41	36	55.42	87	14	18.68	do	Do.
SE. corner of NE. ¼ sec. 6, T. 36 N., R. 7 W.		36	05.10		15	40.50	do	Do.
	39°-40°			85°-86°				
SW. corner of SE. ¼ of SE. ¼ sec. 27, T. 7 N., R. 11 E.	39	01	00.87	85	16	59.40	C. & G. S	Do.

ILLINOIS.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			87°-88°				
	°	′	″	°	′	″		
Benton	42	29	02.87	87	52	44.10	L. S	Final Rept.
Deerfield		10	20.55		50	45.94	do	Do.
Evanston:								
Center tower of Northwest University.		03	06.50		40	34.20	do	Do.
SW. corner sec. 25, T. 41 N., R. 13 W		00	40.60		49	34.40	do	Do.
Waukegan:								
Presbyterian church		21	41.40		50	03.30	do	Do.
Court-house		21	33.90		50	58.60	do	Do.
NW. corner sec. 6, T. 46 N., R. 12 E		29	37.20		52	56.50	do	Do.
SE. corner sec. 24, T. 45 N., R. 11 E		21	21.60		53	06.40	do	Do.
SW. corner sec. 28, T. 43 N., R. 12 E		10	02.30		50	51.60	do	Do.
Park Ridge		00	58.27		49	40.50	do	Do.
Warren		21	26.58		53	23.14	do	Do.
	42°-43°			88°-89°				
Antioch	42	26	03.67	88	03	12.50	do	Do.
Clinton		29	39.34		52	01.15	C. & G. S	Bull. 122.
Deans Corners, Congregational church.		16	38.50		02	41.30	L. S	Final Rept.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			88°-89°				
	°	′	″	°	′	″		
Fremont	42	16	37.18	88	02	44.01	L. S	Final Rept.
Palatine		07	02.94		02	26.62	do	Do.
Spire Methodist Episcopal church		06	46.20		02	37.40	do	Do.
High school building flagstaff		06	48.80		02	31.10	do	Do.
Rock church		22	04.81		56	38.03	C. & G. S	
SW. corner sec. 14, T. 42 N., R. 10 E		06	37.50		02	38.40	L. S	Do.
SW. corner sec. 27, T. 46 N., R. 10 E		25	47.80		03	45.80	do	Do.
	42°-43°			89°-90°				
Newark	42	29	55.62	89	12	36.97	C. & G. S	
Rockton, church		27	23.19		04	15.41	do	
Roscoe, church		28	17.97		03	17.82	do	
State line No. 1		29	49.18		04	25.93	do	
Wadams Grove		24	58.94		52	02.58	do	
Warren		29	38.37		59	16.37	do	
Galena:	42°-43°			90°-91°				
Northeast corner Methodist Episcopal church.	42	25	11.50	90	25	55.70	L. S	Final Rept.
Intersection of fourth principal meridian with State line.		30	26.10		25	33.60	do	Do.
Horseshoe Mound		24	31.56		23	59.71	C. & G. S	
	41°-42°			87°-88°				
Chicago	41	50	01.00	87	50	26.78	L. S	Do.
Tower of waterworks		53	49.80		37	28.30	do	Do.
Light-house		53	20.50		36	52.20	do	Do.
Do		53	22.49		36	48.90	do	Do.
Tall tower of Chicago University		49	58.60		36	45.20	do	Do.
Shot tower		53	11.42		38	30.13	do	Do.
Crete		24	53.57		38	40.50	do	Do.
Cyrus Township, SW. corner sec. 34, T. 38 N., R. 13 W.		43	56.40		51	27.10	do	Do.
Dalton, prominent brick chimney		38	59.20		17	08.40	do	Do.
East base		45	36.06		43	36.69	do	Do.
Frankfort:								
German Lutheran church		29	45.00		50	58.80	do	Do.
Flagstaff of elevator		29	55.50		51	00.80	do	Do.
Garden		26	24.48		49	35.98	do	Do.
Grant		14	50.04		38	49.45	do	Do.
Kankakee		07	06.19		51	40.58	do	Do.
High school building tower		07	06.20		51	40.60	do	Do.
Southwest corner of water table of court-house.		07	09.00		51	38.80	do	Do.
First Baptist church spire		07	12.80		51	39.10	do	Do.
Lombard		54	07.70		59	25.02	do	Do.
Lyons Township, NE. corner sec. 13, T. 38 N., R. 13 W.		47	30.80		48	05.90	do	Do.
Manteno		14	54.96		50	07.43	do	Do.
Northeast corner Catholic church		14	48.80		50	12.50	do	Do.
Methodist church spire		15	09.00		50	16.60	do	Do.
Military Academy		41	21.85		40	32.96	do	Do.
Morgan Park		41	28.60		40	24.98	do	Do.
Baptist church		41	37.20		40	39.50	do	Do.
Orland		34	20.08		51	19.04	do	Do.
Palos Township:								
NW. corner sec. 3, T. 37 N., R. 13 W.		43	56.40		51	25.90	do	Do.
Center of sec. 13, T. 38 N., R. 13 W		47	03.60		48	41.90	do	Do.
St. Anne		01	19.46		43	16.04	do	Do.
Catholic church spire		01	36.20		43	19.60	do	Do.
West base		47	03.40		48	40.33	do	Do.
Willow Springs		43	36.93		51	06.86	do	Do.
Do		43	38.63		51	06.75	do	Do.
Center of sec. 4, T. 39 N., R. 11 E		53	49.50		59	19.40	do	Do.
Center of sec. 8, T. 30 N., R. 13 W		05	55.80		51	34.40	do	Do.
Corner secs. 10, 11, 14, and 15, T. 34 N., R. 13 W.		26	27.00		49	33.00	do	Do.
Corner secs. 15, 16, 21, and 22, T. 32 N., R. 12 E.		15	01.90		50	19.50	do	Do.
Corner secs. 27, 28, 33, and 34, T. 36 N., R. 12 E.		34	20.10		51	06.70	do	Do.
NE. corner sec. 20, T. 32 N., R. 11 W		15	07.30		37	33.30	do	Do.
NE. corner sec. 27, T. 38 N., R. 12 W		45	50.80		43	21.00	do	Do.
NW. corner sec. 4, T. 30 N., R. 11 E		54	18.40		59	54.00	do	Do.
SE. corner sec. 13, T. 37 N., R. 12 W		41	30.50		40	52.40	do	Do.
SW. corner sec. 4, T. 29 N., R. 12 W		01	15.40		43	56.80	do	Do.
SW. corner sec. 20, T. 34 N., R. 11 W		24	47.50		38	05.06	do	Do.
Rock Island:	41°-42°			90°-91°				
Southeast corner of guard-house	41	31	01.50	90	33	46.00	do	Do.
Astronomical post on U. S. Arsenal grounds.		31	03.40		33	40.10	do	Do.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			87°-88°				
	°	′	″	°	′	″		
Ash	40	35	18.36	87	47	49.98	L. S.	Final Rept.
Butler		24	17.70		46	54.55	do	Do.
Clifton		56	14.29		56	16.74	do	Do.
Northeast corner Congregational church.		56	08.60		56	08.90	do	Do.
Schoolhouse tower		56	15.90		56	11.00	do	Do.
Fairmount		01	35.84		50	48.78	do	Do.
Methodist church spire		02	45.10		49	44.80	do	Do.
Baptist church spire		02	43.20		49	51.10	do	Do.
Hoopeston Methodist church spire		28	02.00		40	00.20	do	Do.
Pilot Grove		12	08.60		50	12.60	do	Do.
Spring Creek		40	00.18		59	30.11	do	Do.
Watseka		45	08.69		47	17.39	do	Do.
Court-house tower		46	28.90		44	09.00	do	Do.
Corner secs. 8, 9, 16, and 17, T. 20 N., R. 13 W.		12	07.10		50	45.00	do	Do.
Corner secs. 33 and 34, T. 29 N., R. 14 W.		56	35.80		56	36.50	do	Do.
NE. corner sec. 2, T. 26 N., R. 13 W		46	19.00		47	11.50	do	Do.
NE. corner sec. 35, T. 25 N., R. 13 W		35	19.70		47	07.30	do	Do.
SE. corner sec. 8, T. 18 N., R. 13 W		01	35.30		50	37.10	do	Do.
SE. corner sec. 35, T. 27 N., R. 13 W		46	19.00		47	12.50	do	Do.
SE. corner sec. 35, T. 23 N., R. 13 W		24	05.00		45	46.80	do	Do.
SE. corner sec. 36, T. 23 N., R. 13 W		24	05.70		45	39.00	do	Do.
SW. corner of SE. ¼ of sec. 31, T. 26 N., R. 14 W.		40	46.50		59	00.50	do	Do.
	40°-41°			88°-89°				
Champaign, Illinois Industrial University, center of east tower	40	06	33.10	88	13	38.50	do	Do.
Mayview		06	52.95		07	21.47	do	Do.
Paxton		26	40.47		02	08.20	do	Do.
Congregational church spire		27	37.70		06	00.80	do	Do.
Swedish Evangelical Lutheran church spire.		27	23.00		05	24.40	do	Do.
Rantoul		19	13.84		02	08.67	do	Do.
Steeple with cross		18	37.30		09	25.80	do	Do.
White steeple		18	41.70		09	33.60	do	Do.
Sydney, tall chimney		01	25.60		04	10.70	do	Do.
Center sec. 35, T. 22 N., R. 10 E		19	12.20		01	52.20	do	Do.
Corner secs. 7 and 18, T. 19 N., R. 10 E., and secs. 12 and 13, T. 19 N., R. 9 E.		06	47.80		07	28.90	do	Do.
Corner secs. 14, 15, 22, and 23, T. 23 N., R. 10 E.		26	39.80		02	27.70	do	Do.
Land survey corner ¼ mile E. of corner of secs. 14, 15, 22, and 23, T. 23 N., R. 10 E.		26	39.90		02	10.60	do	Do.
	40°-41°			91°-92°				
Gillham	40	18	41.16	91	26	03.69	Miss. R. C	Rept. '84.
Hamilton		24	12.28		21	30.64	do	Do.
Church spire		23	34.60		20	52.85	do	Rept. '88.
Lima Lake		10	13.14		24	49.15	do	Rept. '84.
Rapids		25	16.66		21	49.71	do	Do.
Warsaw		22	01.44		25	40.96	do	Do.
Methodist Episcopal church spire.		21	40.25		26	05.39	do	Rept. '88.
Presbyterian church spire		21	33.11		26	14.81	do	Do.
Worster		22	49.90		21	54.38	do	Rept. '84.
	39°-40°			87°-88°				
Belle Air	39	10	36.33	87	52	09.33	L. S	Final Rept.
Casey:								
Schoolhouse tower		18	03.80		59	02.10	do	Do.
Methodist church steeple		17	58.40		59	27.90	do	Do.
Kansas		30	51.85		51	48.11	do	Do.
Presbyterian church spire		33	22.70		56	11.60	do	Do.
Methodist church spire		33	08.60		56	22.20	do	Do.
Marshall Catholic church steeple		23	15.40		41	40.90	do	Do.
Martinsville		18	56.71		51	15.48	do	Do.
Palermo		52	33.82		52	03.20	do	Do.
Paris:								
Methodist church spire		36	45.60		41	41.60	do	Do.
Christian church steeple		36	36.20		41	38.96	do	Do.
Center of sec. 5, T. 16 N., R. 13 W		52	21.60		52	16.20	do	Do.
Center of sec. 16, T. 10 N., R. 13 W		19	03.40		51	10.60	do	Do.
Corner of secs. 4 and 5, T. 8 N., R. 13 W., and sec. 32, T. 9 N., R. 13 W.		10	35.20		52	32.60	do	Do.
Corner of secs. 5, 6, 7, and 8, T. 16 N., R. 13 W.		51	55.50		51	42.00	do	Do.
Southwest corner of sec. 4, T. 12 N., R. 13 W.		30	43.30		52	06.40	do	Do.
	39°-40°			88°-89°				
Casey	39	13	33.42	88	01	07.18	do	Do.
Hunt City		03	58.76		00	57.21	do	Do.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			88°-89°				
	°	′	″	°	′	″		
Lynn Grove	39	58	09.97	88	06	36.56	L. S	Final Rept.
Mattoon		29	10.00		23	08.00	do	Do.
Oakland		42	31.90		02	35.30	do	Do.
Westfield		27	15.94		02	41.66	do	Do.
Methodist church, high steeple		27	21.40		00	01.80	do	Do.
Corners of T. 18 N., R. 10 E.; T. 17 N., R. 10 E.; T. 17 N., R. 9 E., and T. 18 N., R. 9 E.		58	03.40		07	24.00	do	Do.
Corner secs. 25, 26, 35, and 36, T. 12 N., R. 10 E.		26	58.70		02	43.00	do	Do.
Land survey mark ¼ mile west of corner of secs. 25, 26, 35, and 36, T. 15 N., R. 10 E.		42	38.20		02	59.00	do	Do.
NE. corner sec. 18, T. 9 N., R. 11 E		13	57.40		00	33.60	do	Do.
NE. corner sec. 7, T. 7 N., fractional R. 11 E.		04	08.20		01	25.80	do	Do.
NW. corner sec. 7, T. 7 N., R. 14 W		04	08.30		01	25.90	do	Do.
	39°-40°			90°-91°				
Belleview	39	21	55.20	90	47	39.66	Miss. R. C	Rept. '84.
Hamburg		14	08.76		43	04.64	do	Do.
Long		28	49.67		55	27.58	do	Do.
Peets		06	18.90		39	52.86	do	Do.
Wilson		02	23.54		40	32.35	do	Do.
	39°-40°			91°-92°				
Gard	39	39	03.99	91	06	52.91	do	Do.
Marble Head		50	41.52		22	22.50	do	Do.
Inner base		29	04.94		01	19.09	do	Do.
Outer base		27	46.74		02	10.35	do	Do.
Quincy		56	31.00		24	51.18	do	Do.
Catholic church spire		55	03.63		24	17.01	do	Rept. '88.
Court-house		56	06.57		24	28.17	do	Do.
Rockport		32	48.61		00	58.40	do	Rept. '84.
	38°-39°			87°-88°				
Claremont	38	45	28.75	87	59	41.54	L. S	Final Rept.
Oblong		59	54.58		52	30.54	do	Do.
SE. corner sec. 32, T. 7 N., R. 13 W		59	51.60		52	17.60	do	Do.
	38°-39°			88°-89°				Do.
Check base	38	48	20.73	88	01	58.29	do	
Denver		46	18.16		12	44.38	do	Do.
Dundas, tower Baptist church		50	06.10		05	03.60	do	Do.
East base		51	44.29		01	35.77	do	Do.
Mound		54	08.38		03	24.15	do	Do.
Olney:								
Tower schoolhouse, corner of Kitchell avenue and Church street.		43	42.00		05	12.60	do	Do.
Dome of court-house		43	50.60		05	08.70	do	Do.
Spire Immanuel's kirche		43	42.80		04	53.50	do	Do.
Onion Hill		48	57.72		10	27.97	do	Do.
Parkersburg		34	51.73		01	49.66	do	Do.
St. Marie, Catholic church		55	56.70		01	30.90	do	Do.
West base		51	38.76		06	09.04	do	Do.
Corner secs. 15, 16, 21, 22, T. 4 N., R. 9 E.		46	28.70		12	22.10	do	Do.
Corner secs. 19, 30, T. 2 N., R. 11 E., and secs. 24, 25, T. 2 N., R. 10 E.		35	07.20		02	18.60	do	Do.
NW. corner sec. 29, T. 4 N., R. 14 W		45	42.50		00	11.90	do	Do.
German Reformed church, in sec. 6, T. 4 N., R. 11 E.		48	21.10		01	59.00	do	Do.
SW. corner NW. ¼ sec. 6, T. 4 N., R. 11 E.		48	46.80		02	18.90	do	Do.
NE. corner sec. 2, T. 4 N., R. 9 E		49	03.50		10	06.40	do	Do.
NE. corner sec. 23, T. 5 N., R. 10 E		51	50.80		03	25.50	do	Do.
NE. corner sec. 21, T. 5 N., R. 10 E		51	47.90		05	41.20	do	Do.
NW. corner sec. 19, T. 5 N., R. 11 E		51	51.90		02	18.40	do	Do.
Corner secs. 1, 2, 11, 12, T. 5 N., R. 10 E		53	37.10		03	25.20	do	Do.
	38°-39°			89°-90°				
Reagan	38	01	29.48	89	59	08.01	do	Do.
	38°-39°			90°-91°				
Alton	38	53	30.96	90	11	35.62	Miss. R. C	Rept. '84.
Catholic church		53	25.88		10	39.34	do	Rept. '88.
Schoolhouse, No. 5		53	31.77		10	12.27	do	Do.
Bocan		22	13.48		15	38.69	do	Rept. '84.
Brewerville		03	35.35		03	23.89	do	Do.
Cahill		59	24.38		40	20.75	do	Do.
Calhoun		55	26.78		34	35.83	do	Do.
Clark Mound		34	45.75		04	13.97	do	Do.
County Line		06	42.21		07	21.36	do	Do.
Droege		58	44.77		37	23.20	do	Do.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			90°-91°				
	°	′	″	°	′	″		
Dryer	38	20	06.33	90	11	55.71	Miss. R. C	Rept. '84.
Eagle Nest		56	04.97		18	40.13	do	Do.
Elsah		57	20.64		22	10.12	do	Do.
Gesler		50	51.51		06	26.25	do	Do.
Glass Works		53	02.06		10	20.84	do	Do.
Gillan		49	36.43		06	32.02	do	Do.
Grafton		58	22.48		27	08.82	do	Do.
Gummershimer		25	43.98		13	42.67	do	Do.
Hop Hollow		54	41.55		13	13.21	do	Do.
Hull		55	11.39		14	09.35	do	Do.
Keel		56	58.38		39	04.41	do	Do.
Kidd		10	22.49		12	58.13	do	Do.
Moore		48	08.12		07	05.82	do	Do.
Point Landing		54	43.53		31	44.55	do	Do.
Pettingill		46	16.76		08	50.56	do	Do.
Reihl		56	12.34		16	40.01	do	Do.
Ringering		51	32.91		07	48.91	do	Do.
Rivermouth		58	21.92		29	41.17	do	Do.
Russell		52	31.18		08	41.63	do	Do.
Salt Bluff		18	35.65		18	05.65	do	Do.
Sawmill		53	55.24		12	10.29	do	Do.
Soechtig		43	03.85		08	50.74	do	Do.
Starr		56	29.12		20	06.18	do	Do.
Sugarloaf		42	05.33		00	28.91	do	Do.
Thompson		58	43.32		32	28.42	do	Do.
Weisenborn		14	24.24		16	26.40	do	Do.
	37°-38°			89°-90°				
Atherton	37	07	23.82	89	22	43.05	do	Do.
Big Muddy		34	32.97		26	08.67	do	Do.
Bluff Lake		25	17.94		20	42.20	do	Do.
Burnham		08	31.43		24	32.43	do	Do.
Chester		54	09.65		48	43.55	do	Do.
Chester, church spire		54	55.36		49	21.22	do	Rept. '88.
Clear Creek		19	56.75		22	44.84	do	Rept. '84.
Day		14	00.04		27	14.93	do	Do.
Dickey		04	08.17		14	43.21	do	Do.
Fountain Bluff		41	36.77		30	00.16	do	Do.
Goose Island		05	35.96		22	58.78	do	Do.
Kaskaskia		57	41.83		55	07.40	do	Rept. '88.
Lassar		11	05.83		26	16.30	do	Rept. '84.
Manskeer		51	54.74		44	40.35	do	Do.
Murray		04	59.32		15	55.00	do	Do.
Nimbus		03	09.04		13	02.69	do	Do.
North base		02	21.94		11	31.84	do	Do.
O'Harrah		49	21.42		38	41.57	do	Do.
Powers Island		07	26.46		24	39.71	do	Do.
Promised Land		05	10.41		20	54.05	do	Do.
Rich		30	37.42		25	58.33	do	Do.
Santa Fe		10	05.16		25	28.60	do	Do.
Scudder		04	25.09		18	35.23	do	Do.
Sexton		15	05.07		26	42.99	do	Do.
South base		01	28.97		11	23.19	do	Do.
Spiese Mill		05	29.90		17	59.58	do	Do.
Swallow Rock		41	31.23		24	19.67	do	Do.
Thebes		12	30.91		27	15.55	do	Do.
Worthen		46	13.45		28	24.07	do	Do.
	36°-37°			89°-90°				
Cairo	36	59	47.99	89	09	31.20	L. S	Final Rept.

MICHIGAN.

	48°-49°			88°-89°				
	°	′	″	°	′	″		
Isle Royale	48	07	43.58	88	33	37.91	L. S	Final Rept.
Light-house		05	23.60		34	45.60	do	Do.
	47°-48°			87°-88°				
Stannard Rock, day beacon	47	10	37.70	87	13	23.10	do	Do.
Vulcan		26	46.65		47	38.17	do	Do.
	47°-48°			88°-89°				
Franklin shaft house	47	08	33.40	88	34	10.20	do	Do.
Traverse Point		08	42.06		13	59.86	do	Do.
Wheat Kate		04	20.27		39	45.21	do	Do.
	46°-47°			85°-86°				
Biddle Point	46	04	32.01	85	22	41.20	do	Do.
Manitou Payment		01	47.76		05	15.61	do	Do

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	46°-47°			86°-87°				
	°	′	″	°	′	″		
Divide	46	21	41.12	86	39	37.71	L. S	Final Rept.
Grand Island		31	43.34		41	35.49	do	Do.
Manistique		08	31.57		35	55.05	do	Do.
Mud Lake		19	14.00		48	24.45	do	Do.
Shelter Bay		28	17.93		59	16.95	do	Do.
Sturgeon		02	26.07		41	10.95	do	Do.
NW. corner of NE. ¼ sec. 16, T. 42 N., R. 19 W.		02	31.40		41	17.40	do	Do.
NE. corner sec. 27, T. 46 N., R. 19 W		21	44.00		39	27.70	do	Do.
SE. corner sec. 4, T. 45 N., R. 20 W		19	06.50		48	13.90	do	Do.
	46°-47°			87°-88°				
Baldwin	46	32	57.85	87	35	05.25	G. S	Bull. 122
Carp		30	06.70		25	05.84	do	Do.
Dexter		30	02.57		47	33.91	do	Do.
F		28	18.28		36	55.47	do	Do.
Granite Island		43	15.47		24	41.29	L. S	Final Rept.
Light-house		43	15.00		24	43.70	do	Do.
Huron Island light-house		57	47.70		59	56.40	do	Do.
Huron Mountains		52	42.30		55	17 59	do	Do.
Ives Hill		49	26.19		50	05.66	do	Do.
Marquette:								
Light-house		32	47.90		22	34.70	do	Do.
Methodist church spire		32	43.40		23	31.70	do	Do.
City hall dome		32	30.00		23	47.60	do	Do.
Mount Mesnard		30	48.34		23	59.23	do	Do.
Morgan		31	48.26		30	55.32	G. S	Bull. 122.
Saginaw		27	41.10		43	00.52	do	Do.
Triloba		36	17.94		29	21.83	L. S	Final Rept.
	46°-47°			88°-89°				
Crebassa	46	59	00.52	88	24	18.17	do	Do.
Middle		55	55.09		14	22.75	do	Do.
North base		56	48.01		26	59.46	do	Do.
Portage River light-house		58	41.10		24	50.70	do	Do.
Quaquaming		52	20.23		22	21.79	do	Do.
South base		52	17.76		29	16.75	do	Do.
	46°-47°			89°-90°				
Ontonagon County light-house	46	52	27.60	89	19	33.40	do	Do.
Porcupine Mountain		47	01.05		43	50.84	do	Do.
	45°-46°			84°-85°				
Beaver Tail	45	57	56.72	84	10	15.24	do	Do.
Bois Blanc Island		46	19.12		21	21.47	do	Do.
East base		45	22.14		42	02.99	do	Do.
Gros Cap		52	57.81		50	06.98	do	Do.
Mackinac Island		51	28.73		36	58.08	do	Do.
Mast		34	28.44		08	25.89	do	Do.
Pointe aux Chênes		55	39.82		54	48.49	do	Do.
Pointe Fuyard		55	58.07		22	48.77	do	Do.
Pointe St. Martin		58	10.21		31	55.29	do	Do.
Rabbit Back		55	17.84		43	18.97	do	Do.
Round Island astronomical station		50	06.81		36	44.60	do	Do.
St. Ignace		51	09.12		43	36.09	do	Do.
Spectacle Reef		46	05.02		08	10.73	do	Do.
West base		47	13.80		46	22.40	do	Do.
	45°-46°			85°-86°				
Beaver Island	45	36	25.56	85	29	49.27	do	Do.
Cathead		10	58.09		37	05.65	do	Do.
Garden Island		49	19.46		31	13.82	do	Do.
Gull Island		42	09.24		50	00.32	do	Do.
Hat Island		49	01.87		17	57.18	do	Do.
High Island		43	54.35		41	01.50	do	Do.
Middle Village		34	42.39		06	13.43	do	Do.
North Fox		28	09.94		46	26.25	do	Do.
North Manitou		03	51.52		59	44.32	do	Do.
Pine River		19	55.73		14	50.43	do	Do.
Point Patterson		58	04.29		39	15.18	do	Do.
Seul Choix		55	14.69		54	40.40	do	Do.
Scott Point		57	34.63		41	44.46	do	Do.
South Fox		24	58.05		51	37.49	do	Do.
	45°-46°			86°-87°				
Boyer Bluff	45	25	12.81	86	56	11.49	do	Do.
Burnt Bluff		41	09.73		42	39.83	do	Do.
Fishdam		57	37.33		29	34.19	do	Do.
Northwest Manitou		09	23.00		02	46.52	do	Do.
Peninsula Point light-house		40	04.60		58	02.40	do	Do.
Pine Hill		51	36.96		53	55.48	do	Do.
Rock Island		24	53.11		49	00.00	do	Do.
South Manitou		00	35.24		09	01.74	do	Do.

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	45°-46°			87°-88°				
	°	′	″	°	′	″		
Bark River	45	34	30.78	87	14	25.94	L. S.	Final Rept.
Cedar River		25	48.62		19	35.05	do	Do.
Door Bluff		17	46.97		03	54.60	do	Do.
Ford River		41	05.34		06	01.35	do	Do.
Do		41	12.16		06	09.40	do	Do.
Menomonee, new primary triangulation station.		05	12.78		35	27.75	do	Do.
Rochereau		17	41.23		26	12.51	do	Do.
SE. corner sec. 12, T. 38 N., R. 23 W		41	12.90		06	03.40	do	Do.
	44°-45°			82°-83°				
Pointe aux Barques	44	04	05.58	82	57	32.52	do	Do.
	44°-45°			83°-84°				
Big Charity	44	02	17.46	83	26	27.97	do	Do.
Charity light-house		02	16.30		26	27.70	do	Do.
Gravelly Point		02	58.79		34	44.06	do	Do.
Little Charity		00	03.81		28	02.72	do	Do.
Mason Creek		11	39.56		33	20.34	do	Do.
Pointe au Sable		20	17.79		20	03.64	do	Do.
Tawas light-house		15	35.40		26	37.70	do	Do.
Tawas Point		15	38.14		26	29.19	do	Do.
Whitestone		06	24.72		33	54.33	do	Do.
	44°-45°			85°-86°				
Pyramid Point	44	58	04.40	85	55	28.16	do	Do.
	44°-45°			86°-87°				
Pointe aux Becs Scies	44	41	48.58	86	14	59.36	do	Do.
Sleeping Bear		52	22.69		04	03.05	do	Do.
	43°-44°			83°-84°				
East base	43	54	55.71	83	19	10.78	do	Do.
Fish Point		42	49.02		31	39.49	do	Do.
Flint:								
Intersection of Keasley and East streets.		01	11.71		41	06.45	do	Do.
Intersection of Keasley and Saginaw streets.		01	01.20		41	29.30	do	Do.
Lapeer:								
Intersection of Calhoun and Liberty streets.		03	08.60		18	53.50	do	Do.
Intersection of Calhoun and Franklin streets.		03	07.30		18	53.40	do	Do.
Nyaquonk		47	24.74		55	32.76	do	Do.
Oak Point		58	29.77		15	40.03	do	Do.
Observatory		54	39.79		22	51.00	do	Do.
Pine River		58	42.70		51	13.62	do	Do.
Pointe aux Gres		59	27.88		40	38.96	do	Do.
Quannakissee		37	03.81		44	10.09	do	Do.
Saginaw River light-house		38	37.80		51	17.50	do	Do.
Saginaw:								
Court-house, east corner		25	05.70		57	50.30	do	Do.
Jail, south corner		25	08.40		57	48.40	do	Do.
Intersection of Adams and Washington streets.		25	02.00		57	50.20	do	Do.
Sebonin		51	32.16		26	57.65	do	Do.
West base		54	39.15		23	56.71	do	Do.
Wild fowl		51	24.53		21	28.39	do	Do.
NE. corner sec. 26, T. 12 N., R. 4 E		25	27.10		57	25.30	do	Do.
SW. corner of SW. ¼ of sec. 32, T. 8 N., R. 10 E.		03	26.30		18	55.60	do	Do.
	43°-44°			84°-85°				
St. Johns:								
Intersection of axes of State and Ottawa streets.	43	00	02.60	84	33	47.00	do	Do.
Corner stone at northwest corner of court-house.		00	00.10		33	37.20	do	Do.
Intersection of axes of Clinton avenue and State street.		00	02.39		33	36.60	do	Do.
St. Louis, intersection of Washington and Mill streets.		24	33.00		36	24.70	do	Do.
NW. corner sec. 16, T. 7 N., R. 2 W		00	02.80		33	51.10	do	Do.
SW. corner sec. 19, T. 12 N., R. 2 W		24	33.00		36	19.00	do	Do.
	43°-44°			85°-86°				
Stanton:								
County record office, northwest corner.	43	17	29.00	85	04	58.40	do	Do.
Intersection of Main and Camburn streets.		17	30.70		04	52.50	do	Do.
SW. corner sec. 31, T. 11 N., R. 6 W		17	30.70		05	03.20	do	Do.
SW. corner sec. 18, T. 12 N., R. 12 W		25	26.10		48	10.40	do	Do.
	42°-43°			83°-84°				
Barker	42	07	30.50	83	03	26.30	do	Do.
Biddle		03	02.90		03	17.80	do	Do.

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			83°-84°				
	°	′	″	°	′	″		
Brodhead	42	09	30.50	83	08	15.90	L. S.	Final Rept.
Detroit:								
Astronomical post (east pier) in lake observatory.		20	00.80		08	07.40	do	Do.
Intersection of axes of Washington and Grand River avenues.		20	01.40		03	04.50	do	Do.
Spire St. Paul's Episcopal church, on northeast corner of Congress and Shelby streets.		19	45.90		02	53.60	do	Do.
Tower of fire-engine house on Russell street.		20	41.00		02	21.50	do	Do.
East pier lake survey observatory.		19	58.65		03	08.60	do	Do.
Ecorse		15	21.40		08	09.50	do	Do.
Field		17	34.20		08	23.10	do	Do.
Howell:								
Astronomical post		36	00.24		55	44.25	Engr. Corps.	Rept. '76.
Intersection Higgins and Monroe streets.		36	11.18		55	50.85	L. S	Final Rept.
Intersection of axes of Grand River and Higgins streets.		36	23.20		55	42.60	do	Do.
Southwest corner of court-house.		36	24.50		55	41.40	do	Do.
North Wyandotte		12	49.20		08	48.50	do	Do.
Pointe Monillée		00	49.60		10	53.70	do	Do.
Pontiac:								
Methodist Episcopal church spire.		38	08.20		17	20.50	do	Do.
Intersection of axes of Saginaw and Church streets.		38	06.70		17	22.60	do	Do.
Court-house cupola		38	22.00		17	30.00	do	Do.
SE. corner sec. 29, T. 3 N., R. 10 E.		38	06.95		17	15.60	do	Do.
River Rouge		16	15.40		07	34.90	do	Do.
Tecumseh Presbyterian church		00	15.00		56	54.60	do	Do.
Sugar Island		05	25.40		08	35.40	do	Do.
NW. corner sec. 1, T. 2 N., R. 4 E.		35	59.60		56	01.60	do	Do.
SE. corner, sec. 29, T. 3 N., R. 10 E		38	07.00		17	15.50	do	Do.
	42°-43°			84°-85°				
Bunday	42	03	16.04	84	27	42.10	do	Do.
Charlotte:								
Intersection of axes of Oliver and Stoddard streets.		33	58.96		50	01.20	do	Do.
Jail, northwest corner		33	52.40		50	13.90	do	Do.
Corunna:								
Intersection of axes of McArthur street and Shiawassee avenue.		58	52.00		07	02.90	do	Do.
Intersection of axes of Shiawassee avenue and Flint road.		58	37.92		07	02.85	do	Do.
Court-house, southwest corner		58	54.30		07	00.80	do	Do.
Northeast corner schoolhouse on corner of State street and Shiawassee avenue.		58	47.50		07	05.00	do	Do.
Jackson:								
Cornwell & Emerson's chemical works, brick chimney.		15	45.50		24	23.90	do	Do.
Hibbard House, northeast corner.		14	48.90		24	13.70	do	Do.
First Methodist Episcopal church spire.		14	50.00		24	39.60	do	Do.
Intersection of axes of Main and Mechanics streets.		14	49.40		24	19.20	do	Do.
Michigan State Prison, main tower		14	34.70		24	36.60	do	Do.
Intersection of axes of Main and Jackson streets.		14	49.40		24	30.00	do	Do.
Lansing:								
Dome of capitol		43	56.10		33	23.20	do	Do.
Intersection of Washtenaw and Washington avenues.		43	47.60		33	11.20	do	Do.
Intersection of Michigan and Capitol avenues.		43	55.79		33	16.95	do	Do.
Marshall.								
Intersection of Kalamazoo avenue and Mansion street.		16	24.70		57	49.20	do	Do.
Court-house, northwest corner		16	16.70		57	47.00	do	Do.
NE. corner sec. 16, T. 4 N., R. 2 W		44	21.90		32	37.40	do	Do
NE. corner sec. 13, T. 2 N., R. 5 W		34	04.30		50	10.10	do	Do.
NW. corner sec. 2, T. 3 S., R. 1 W		14	49.30		24	12.40	do	Do.
NW. corner sec. 25, T. 2 S., R. 6 W		16	27.60		57	49.20	do	Do.
SE. corner sec. 8, T. 5 S., R. 1 W		03	55.00		29	00.40	do	Do
SW. corner sec. 28, T. 7 N., R 3 E		58	11.20		07	40.30	do	Do.
	42°-43°			85°-86°				
Allegan:								
County record building, northwest corner.	42	31	44.70	85	51	08.50	do	Do.

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			85°-86°				
	°	′	″	°	′	″		
Allegan—Continued.								
Intersection of axes of Walnut and Trowbridge streets.	42	31	45.60	85	51	09.70	L. S.	Final Rept.
Northwest corner county building, public square.		31	44.74		51	08.55	do	Do.
Grand Rapids:								
SW. corner of NW. ¼ of sec. 30, T. 7 N., R. 11 W., at intersection of Fulton and Division streets.		57	47.00		40	06.20	do	Do.
Intersection of axes of Fulton street and Jefferson avenue.		57	47.10		39	52.90	do	Do.
Hastings:								
Intersection of Church and State streets.		38	54.13		17	17.55	do	Do.
Court-house, southwest corner		38	51.60		17	20.40	do	Do.
Intersection of axes of Broadway and Court streets.		38	50.70		17	23.00	do	Do.
Ionia:								
Intersection of axes of Main and Kidd streets.		58	51.90		03	47.00	do	Do.
Intersection of axes of Main and First streets.		58	51.39		03	53.25	do	Do.
Southeast corner of corner stone of projected soldiers' monument.		58	52.90		03	49.70	do	Do.
Kalamazoo:								
Intersection of axes of South and Church streets.		17	24.60		35	07.30	do	Do.
Intersection of axes of South and Park streets.		17	24.46		35	11.70	do	Do.
Jail, southwest corner		17	28.40		35	05.70	do	Do.
Paw Paw, intersection of axes of Main and Van Buren streets.		13	01.70		53	03.40	do	Do.
NW. corner sec. 17, T. 3 N., R. 8 W		39	11.00		17	23.30	do	Do.
NW. corner sec. 28, T. 2 N., R. 13 W		32	10.50		51	32.10	do	Do.
SE. corner of NE. ¼ of sec. 19, T. 7 N., R. 6 W.		58	42.10		03	18.60	do	Do.
SW. corner sec. 7, T. 3 N., R. 13 W		12	55.00		52	40.40	do	Do.
SW. corner sec. 15, T. 2 S., R. 11 W		17	21.00		35	20.10	do	Do.
	42°-43°			86°-87°				
St. Joseph, Congregational church spire.	42	06	19.00	86	29	00.10	do	Do.
SW. corner sec. 36, T. 1 N., R. 17 W		25	08.80		15	56.30	do	Do.
	41°-42°			83°-84°				
Bedford	41	49	11.15	83	37	06.14	do	Do.
Blissfield		51	08.39		48	27.86	do	Do.
Dundee		55	28.08		40	13.93	do	Do.
Middle Sister		50	53.03		00	07.80	do	Do.
Monroe		55	04.51		28	16.17	do	Do.
Court-house steeple		54	48.65		23	46.35	do	Do.
Methodist Episcopal church spire		54	52.40		23	56.60	do	Do.
Presbyterian church spire		54	53.40		23	51.40	do	Do.
German Lutheran church spire		54	43.40		23	49.10	do	Do.
Light-house		53	27.70		19	53.20	do	Do.
Raisin		57	11.50		55	30.14	do	Do.
Stony Point		55	53.86		15	51.38	do	Do.
Corner of secs. 14, 15, 22, and 23, T. 6 S., R. 4 E.		56	57.10		55	34.30	do	Do.
Corner of secs. 22, 23, 26, and 27, T. 7 S., R. 5 E.		50	57.00		48	26.90	do	Do.
Corner of secs. 25, 26, 35, and 36, T. 6 S., R. 6 E.		55	28.20		40	18.70	do	Do.
NE. corner sec. 5, T. 8 S., R. 7 E.		49	19.80		36	32.40	do	Do.
	41°-42°			84°-85°				
Adrian, flagstaff on engine house	41	53	45.40	84	01	36.80	do	Do.
Fairfield		48	56.12		02	37.00	do	Do.
Hillsdale		55	14.25		39	01.08	do	Do.
Court-house dome		55	15.40		37	54.60	do	Do.
College clock tower		55	57.00		38	02.00	do	Do.
Hudson Congregational church spire		51	12.60		21	25.80	do	Do.
Pittsford		49	33.25		29	00.51	do	Do.
Prattville church		46	50.10		24	00.10	do	Do.
Quincy		57	40.01		55	20.05	do	Do.
Reading		50	06.06		44	31.56	do	Do.
Schoolhouse cupola		50	16.20		44	45.40	do	Do.
Colby Wringer Co. factory, southeast corner.		50	07.10		44	33.20	do	Do.
First Baptist church spire		50	18.50		44	46.80	do	Do.
Wheatland		55	06.32		27	19.48	do	Do.
Woodstock		59	12.55		15	35.76	do	Do.

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			84°-85°				
	°	′	″	°	′	″		
Corner of secs. 19, 20, 29, and 30, T. 6 S., R. 1 E.	41	55	38.60	84	27	34.20	L. S	Final Rept
Corner of secs. 22, 23, 26, and 27, T. 7 S., R. 4 W.		50	22.70		44	53.20	do	Do.
NE. corner sec. 3, T. 8 S., R. 3 E.		49	00.20		02	30.10	do	Do.
NE. corner sec. 4, T. 6 S., R. 1 E.		59	11.90		14	46.60	do	Do.
NE. corner sec. 26, T. 7 S., R. 4 W		50	22.40		43	42.60	do	Do.
NW. corner sec. 27, T. 6 S., R. 3 W		55	38.10		39	05.00	do	Do.
SE. corner sec. 36, T. 7 S., R. 2 W		48	41.00		28	34.80	do	Do.
SW. corner of SW. ¼ of sec. 7, T. 6 S., R. 5 W.		57	22.70		55	55.70	do	Do.
SW. corner of NW. ¼ of sec. 27, T. 6 S., R. 3 W.		55	11.90		39	05.10	do	Do.
SW. corner of NW. ¼ of sec. 29, T. 6 S., R. 1 W.		55	12.70		27	34.20	do	Do.
	41°-42°			85°-86°				
Bronson	41	51	22.46	85	14	38.98	do	Do.
Calvin		50	10.38		55	27.18	do	Do.
Constantine schoolhouse, north cupola		50	07.10		40	01.10	do	Do.
Porter		49	22.48		46	00.10	do	Do.
Sherman		50	48.58		27	12.45	do	Do.
Sturgis:								
Presbyterian church spire		48	03.50		25	08.50	do	Do.
Methodist Episcopal church spire		48	01.20		25	06.80	do	Do.
Schoolhouse		48	05.60		25	11.20	do	Do.
Three Rivers:								
Tall steeple		56	54.20		38	04.50	do	Do.
Church		56	59.00		38	06.80	do	Do.
White Pigeon:								
First Baptist church		47	47.40		38	35.40	do	Do.
Woolen mill		47	41.90		38	28.90	do	Do.
SW. corner of SW. ¼ of sec. 16, T. 7 S., R. 8 W.		51	16.10		14	36.00	do	Do.
SW. corner of SE. ¼ of sec. 22, T. 7 S., R. 10 W.		50	21.40		27	28.80	do	Do.
SW. corner of NW. ¼ of sec. 27, T. 7 S., R. 14 W.		49	57.70		56	07.30	do	Do.
SW. corner of NW. ¼ of sec. 36, T. 7 S., R. 13 W.		48	59.40		46	47.40	do	Do.
	41°-42°			86°-87°				
Bald Tom	41	54	19.34	86	35	59.45	do	Do.
Bertrand		46	44.96		22	40.33	do	Do.
Milton		48	09.36		10	29.74	do	Do.
Corner secs. 4, 5, 8, and 9, T. 8 S., R. 16 W.		47	49.80		11	10.30	do	Do.
Corner secs. 14, 15, 22, and 23, T. 8 S., R. 18 W.		46	34.90		22	39.70	do	Do.
SE. corner sec. 35, T. 6 S., R. 20 W		53	58.60		35	23.90	do	Do.

WISCONSIN.

	47°-48°			90°-91°				
	°	′	″	°	′	″		
Outer Island	47	04	17.09	90	26	27.25	L. S	Final Rept
Bayfield County:	46°-47°			90°-91°				
Light-house on Raspberry Island	46	58	12.80	90	48	16.70	do	Do.
Light-house on Michigan Island		52	16.30		29	48.80	do	Do.
Detour		56	36.68		58	09.32	do	Do.
	46°-47°			91°-92°				
Aminicon	46	41	32.14	91	51	43.59	do	Do.
Brulé		45	17.89		35	18.79	do	Do.
Clay Banks		49	05.61		18	40.63	do	Do.
	46°-47°			92°-93°				
South base	46	42	49.44	92	01	55.13	do	Do.
	45°-46°			86°-87°				
Door County, light-house on Rock Island (Pottawatomie).	45	25	39.50	86	49	41.60	do	Do.
Boyer Bluff		25	12.74		56	11.48	do	Do
	45°-46°			87°-88°				
Door Bluff	45	17	46.97	87	03	54.60	do	Do.
Door County, light-house on Eagle Bluff.		10	07.50		14	12.30	do	Do.
Do		12	08.20		21	53.60	do	Do.
Eagle Bluff		10	06.62		14	13.66	do	Do.
Menomonee		05	12.76		35	34.60	do	Do.

WISCONSIN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	45°-46°			87°-88°				
	°	′	″	°	′	″		
nto County:								
NE. corner sec. 3, T. 30 N., R. 23 E.	45	06	24.20	87	30	42.90	L. S	Final Rept.
Light-house on Green Island		03	23.20		20	34.60	do	Do.
Croix County:	45°-46°			92°-93°				
SE. corner sec. 34, T. 31 N., R. 19 W.	45	07	21.80	92	41	24.60	do	Do.
SW. corner sec. 33, T. 31 N., R. 19 W.		07	22.10		43	52.10	do	Do.
	44°-45°			87°-88°				
wn County, NW. corner sec. 25, .24 N., R. 21 E.	44	31	53.70	87	54	25.20	do	Do.
ice		31	39.37		53	58.14	do	Do.
roux		50	19.43		36	28.84	do	Do.
es		51	14.48		51	26.86	do	Do.
le Tail		41	14.76		59	23.07	do	Do.
g Tail Point		35	49.10		58	59.20	do	Do.
htigo		59	06.73		37	43.23	do	Do.
Banks		36	40.26		51	54.19	do	Do.
River		45	40.00		41	07.07	do	Do.
th Egg		59	20.75		21	05.79	do	Do.
	44°-45°			88°-89°				
leton, St. Lawrence University, nter of dome.	44	15	39.20	88	23	58.80	do	Do.
met		10	12.64		16	45.78	do	Do.
County, NW. corner sec. 31, T. 20 N., R. 19 E.		10	12.80		17	02.20	do	Do.
ton		12	04.07		32	41.11	do	Do.
Depere		24	19.52		00	27.38	do	Do.
Howard		30	30.28		02	34.05	do	Do.
dom		20	06.61		22	00.92	do	Do.
en Bay, court-house dome		30	50.90		00	48.00	do	Do.
ida		31	36.53		10	09.68	do	Do.
agamie County, SE. corner sec. T. 21 N., R. 17 E.		14	38.70		23	43.70	do	Do.
kosh		01	13.64		32	28.14	do	Do.
kbridge		06	16.17		19	26.12	do	Do.
t Depere		24	12.73		16	16.02	do	Do.
nebago County, SW. corner sec. T. 20 N., R. 16 E.		11	58.90		32	39.30	do	Do.
roe County:	44°-45°			90°-91°				
NE. corner sec. 1, T. 18 N., R. 1 W.	44	04	26.60	90	25	56.70	do	Do.
SE. corner sec. 13, T. 18 N., R. 1 W.		01	49.60		25	56.00	do	Do.
ey Junction, SW. corner sec. 31, 21 N., R. 3 E.		14	57.24		25	56.70	do	Do.
raukee:	43°-44°			87°-88°				
Court-house, axis of figure of Justice.	43	02	31.80	87	54	18.40	do	Do.
Catholic church spire		02	30.50		54	15.00	do	Do.
	43°-44°			88°-89°				
wn church	43	16	42.19	88	52	53.63	C. & G. S	
y		23	19.58		04	37.41	G. S	Bull. 122.
field		01	56.97		23	34.00	L. S	Final Rept.
Do		01	59.46		23	29.35	C. & G. S	
ge County:								
SW. corner of SE. ¼ sec. 24, T. 12 N., R. 15 E.		28	24.50		44	01.90	L. S	Do.
NW. corner of SW. ¼ sec. 3, T. 9 N., R. 16 E.		16	36.00		35	48.60	do	Do.
SW. corner sec. 3, T. 9 N., R. 16 E		16	09.70		35	48.30	do	Do.
SE. corner sec. 33, T. 12 N., R. 16 E.		27	28.60		34	52.60	do	Do.
NW. corner sec. 3, T. 13 N., R. 16 E.		37	56.70		34	55.10	do	Do.
SE. corner of SW. ¼ sec. 33, T. 11 N., R. 17 E.		22	14.30		29	29.00	do	Do.
SE. corner sec. 32, T. 11 N., R. 17 E.		22	14.30		30	04.70	do	Do.
base		42	39.67		28	42.05	do	Do.
rado		52	20.81		34	54.97	do	Do.
		14	39.00		19	39.88	G. S	Bull. 122.
Do		14	41.49		19	35.18	C. & G. S	
d du Lac County:								
Spire of Catholic church in Byron Township.		40	29.00		27	02.50	L. S	Final Rept.
NE. corner sec. 10, T. 14 N., R. 16 E.		42	19.00		33	47.30	do	Do.
SW. corner sec. 10, T. 16 N., R. 16 E.		51	54.30		35	03.80	do	Do.
NW. corner SW. ¼ sec. 34, T. 14 N., R. 16 E.		38	22.50		34	54.90	do	Do.
SW. corner sec. 34, T. 14 N., R. 16 E.		37	56.60		34	54.30	do	Do.
NW. corner sec. 4, T. 14 N., R. 17 E.		43	08.60		28	56.10	do	Do.
SW. corner sec. 20, T. 16 N., R. 18 E.		50	01.70		22	55.40	do	Do.
		20	41.62		15	51.27	G. S	Bull. 122.
kcon		28	11.07		34	54.84	L. S	Final Rept.

WISCONSIN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			88°-89°				
	°	′	″	°	′	″		
Jefferson:								
Catholic church	43	00	20.30	88	46	41.19	C. & G. S	
Methodist Episcopal church		00	27.10		48	05.67	do	
Kewaskum		29	38.18		13	33.43	G. S	Bull. 122.
Lebanon		16	37.61		35	29.84	C. & G. S	
Do		16	35.13		35	34.51	L. S	Final Rept.
Minnesota Junction		28	28.45		43	47.54	do	Do.
New Lisbon		08	16.85		11	57.32	do	Do.
Oakfield		38	20.04		34	38.51	do	Do.
Springvale		46	05.32		43	54.06	do	Do.
Taycheedah		50	06.63		22	19.17	do	Do.
Watertown, church		11	43.03		43	39.49	C. & G. S	
Waupun		37	45.11		43	49.81	L. S	Do.
West base		41	50.58		34	06.62	do	Do.
Woodland		22	37.90		28	51.60	G. S	Bull. 122.
Do		22	14.71		29	50.48	L. S	Final Rept.
	43°-44°			89°-90°				
Arena, church belfry	43	09	53.11	89	54	46.38	C. & G. S	
Arlington		19	42.84		18	14.00	do	
Blue Mounds		01	43.57		51	04.60	do	
Burke		07	01.65		16	48.41	do	
Courtland		30	04.98		06	37.52	do	
Deerfield, church		02	29.06		06	21.96	do	
Devils Lake		24	03.37		43	41.59	do	
Fitz Simmons		25	42.56		39	10.30	do	
Gibraltar		20	37.75		35	56.06	do	
Insane asylum		08	00.13		23	48.29	do	
Liberty Mound		01	00.30		09	40.75	do	
McFarland, church		00	57.78		17	05.04	do	
Madison:								
Astronomic station (1873), stone		04	33.03		24	03.41	do	
Baptist church		04	26.44		23	01.13	do	
Capitol		04	31.42		22	58.22	do	
City Hall		04	34.43		23	04.24	do	
Episcopal church		04	28.73		23	03.96	do	
Congregational church		04	26.52		23	07.18	do	
Irish Catholic church		04	22.23		23	04.41	do	
Presbyterian church		04	40.23		23	08.53	do	
University		04	38.81		24	10.39	do	
Mazomanie church, white steeple		10	42.56		47	47.55	do	
Medina		07	38.96		02	11.84	do	
Norwegian church		00	23.86		41	24.11	do	
Observatory Hill		42	22.04		20	29.06	do	
Springfield		10	30.04		36	47.84	do	
St. Martin's church		10	55.68		35	21.23	do	
Stewart		12	01.90		56	37.26	do	
Sun Prairie, highest church spire		11	08.97		12	36.13	do	
Windsor		14	23.94		16	18.35	do	
	43°-44°			90°-91°				
Bear Bluff	43	13	04.04	90	08	35.23	do	
Big Hollow		12	45.42		05	43.04	do	
Brown church steeple		02	55.67		16	45.80	do	
Helena		09	03.44		00	30.78	do	
Railroad bridge, bolt		10	28.79		01	50.08	do	
Highland		06	06.55		21	51.28	do	
Catholic church		02	49.26		22	53.51	do	
Lone Rock:								
Church spire		11	02.75		11	57.53	do	
Bluff		09	54.20		13	00.66	do	
Meridian station, 2		07	57.51		25	43.07	do	
Pine Knobs		04	38.46		01	59.09	do	
Point Judas		13	07.82		13	53.99	do	
Quarry Bluff		12	23.38		03	26.63	do	
Spring Green:								
Methodist Episcopal church spire		10	43.38		04	05.36	do	
Base, east end		09	41.40		03	45.04	do	
Base, west end		10	46.50		06	52.10	do	
Wyoming		04	28.92		10	54.38	do	
	42°-43°			87°-88°				
Caledonia	42	45	32.89	87	56	48.43	L. S	Final Rept.
Kenosha, Catholic church spire		35	32.90		49	17.70	do	Do.
Racine, Methodist Episcopal church		43	28.70		46	56.90	do	Do.
Somer		37	10.07		52	33.60	do	Do.
	42°-43°			88°-89°				
Bald Bluff	42	50	42.76	88	36	15.73	C. & G. S	
Bristol		32	51.61		02	08.78	L. S	Do.
Clinton:								
Norwegian Lutheran church		29	37.73		50	35.04	C. & G. S	
Junction church		33	41.82		51	38.34	do	
Darien church		35	59.85		42	24.49	do	

WISCONSIN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			88°-89°				
	°	′	″	°	′	″		
ver	42	40	25.35	88	05	03.68	L. S	Final Rept.
neva		37	07.79		32	08.96	C. & G. S	
rmony		42	34.43		55	16.83	do	
w Berlin		58	17.60		11	01.80	L. S	Do.
kland		59	14.40		53	45.16	C. & G. S	
piere church		34	16.69		56	12.62	do	
aterford		47	34.91		13	50.73	L. S	Do.
hitewater		50	13.32		44	33.45	C. & G. S	
Congregational church		50	05.05		44	05.54	do	
ukesha County, NW. corner sec.). T. 6 N., R. 20 E.		58	25.80		11	16.30	L. S	Do.
oit:	42°-43°			89°-90°				
City school	42	30	03.17	89	01	30.66	C. & G. S	
College, main building		30	13.36		01	46.84	do	
Baptist church		30	01.65		01	53.45	do	
Congregational church		30	08.13		01	35.79	do	
Memorial Hall		30	08.66		01	44.94	do	
Presbyterian church		29	57.06		01	55.71	do	
tennial, Methodist Episcopal hurch.		42	19.25		50	04.74	do	
rch of the Disciples		42	33.71		10	49.25	do	
gerton church		50	13.44		04	13.89	do	
nsville, seminary		46	39.22		18	03.02	do	
ette		43	16.80		59	38.09	do	
hburg		58	45.77		26	07.65	do	
esville		42	47.86		03	39.79	do	
Blind Institute		39	55.91		02	20.37	do	
City school		40	57.56		00	53.22	do	
nolia		42	29.04		17	44.87	do	
roe:								
Methodist Episcopal church		36	08.00		38	29.52	do	
Congregational church		36	15.01		38	09.72	do	
Universalist church		36	13.82		38	16.81	do	
nt Pleasant		41	30.25		29	45.78	do	
rark		29	55.62		12	36.97	do	
Baptist church		34	14.11		10	00.58	do	
Lutheran church		34	42.32		12	22.97	do	
Norwegian Lutheran church		45	35.42		54	17.00	do	
sant Springs		57	15.42		08	08.98	do	
nouth		35	24.46		10	04.29	do	
k church		57	14.36		02	48.01	do	
on		47	28.75		12	21.88	do	
lford		32	51.49		05	57.45	do	
	42°-43°			90°-91°				
nuth mark	42	30	03.19	90	13	37.24	do	
own		50	02.93		46	26.62	do	
geville, church steeple		57	43.77		07	45.27	do	
Do		57	45.60		07	51.44	do	
ch Hollow church		41	29.60		40	49.75	do	
imore		58	28.53		40	45.85	do	
Church		58	55.87		30	06.79	do	
iot Grove		32	34.57		13	37.40	do	
ker		59	03.23		10	29.78	do	
idian Station No. 1		45	45.28		25	30.22	do	
eral Point, Catholic church		51	34.35		11	06.10	do	
nt Ida		57	20.95		45	29.70	do	
te Mound		45	55.05		24	16.53	do	
tsville, Normal School		44	09.47		28	48.52	do	
lsburg, Catholic church		34	32.96		13	45.99	do	
inawa Mound		31	32.08		32	32.13	do	
dwick		52	29.14		05	51.35	do	
dmill		58	54.14		20	01.96	do	
gville church		58	25.01		25	53.54	do	
corner sec. 31, T. 1 N., R. 1 W., ant County.		30	26.40		26	44.20	L. S	Do.

MINNESOTA.

	47°-48°			89°-90°				
	°	′	″	°	′	″		
uhar Knob	47	52	40.18	89	59	23.77	L. S	Final Rept.
	47°-48°			91°-92°				
ington	47	01	49.46	91	38	29.36	do	Do.
Sawteeth		23	19.02		10	15.79	do	Do.
Rock		11	16.03		23	11.01	do	Do.
t Sawteeth		22	19.08		11	43.63	do	Do.

MINNESOTA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	46°-47° ° ′ ″	91°-92° ° ′ ″		
Buchanan	46 56 28.07	91 47 19.82	L. S	Final Rept
Lester	51 55.11	59 14.32	do	Do.
	46°-47°	92°-93°		
Minnesota Point, light-house	46 42 36.20	92 01 33.00	do	Do.
North base	45 27.89	04 43.26	do	Do.
Oneota	45 18.54	07 59.85	do	Do.
	45°-46°	93°-94°		
Mound View	45 05 30.53	93 10 02.11	C. & G. S	
	44°-45°	92°-93°		
Hampton	44 36 36.74	92 56 26.73	do	
Prescott	46 40.86	45 41.59	do	
Red Wing:				
Spire Catholic church	33 44.64	31 49.65	L. S	Do.
Astronomic monument				
Woodbury	54 51.97	56 38.02	C. & G. S	
	44°-45°	93°-94°		
Buck Hill	44 43 22.90	93 17 04.84	do	
Hopkins	55 10.44	27 25.90	do	
Marcotta	48 52.32	02 56.48	do	
Prospect Park	58 06.38	12 36.28	do	
Ramsey	59 19.21	00 18.97	do	
St. Paul:				
North base	59 42.44	09 51.34	do	
South base	54 59.81	09 52.02	do	
SE. corner of custom-house	56 43.00	05 34.00	do	
Wallace	54 19.55	05 12.14	do	
Washburn Home	54 46.49	16 36.07	do	

IOWA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43° ° ′ ″	90°-91° ° ′ ″		
Sherrill Mound	42 36 17.21	90 47 33.37	C. & G. S	
	41°-42°	95°-96°		
Bluffs	41 14 32.44	95 50 35.43	Mo. R. C	Rept. '91.
Council	16 32.75	51 09.91	do	Do.
Crescent	21 09.58	52 16.73	do	Do.
Henton	06 04.82	49 00.85	do	Do.
Loveland	30 08.67	53 16.76	do	Do.
Taylor	41 13.15	56 31.47	do	Do.
	40°-41°	91°-92°		
Boardman	40 24 39.68	91 26 23.95	Miss. R. C	Rept. '84.
Hughes	24 38.06	24 09.13	do	Do.
Keokuk	24 34.70	22 44.81	do	Do.
Mrs. W. H. Sample's house	23 40.93	22 42.98	do	Rept. '88.
Presbyterian church spire	23 53.11	23 03.69	do	Do.
Unitarian church spire	23 49.32	22 47.62	do	Do.
Lower base	25 04.58	22 55.52	do	Rept. '84.
Upper base	25 43.51	23 16.34	do	Do.
Yellow Banks	24 24.65	29 20.13	do	Do.
	40°-41°	95°-96°		
Hamburg	40 33 20.06	95 37 40.83	Mo. R. C	Rept. '91.
McCracken	40 27.16	42 12.33	do	Do.
Pugh	46 33.28	44 22.71	do	Do.
Quarry	56 27.62	47 10.92	do	Do.
Thurman	50 55.04	45 34.40	do	Do.

MISSOURI

Name.	Latitude.	Longitude.	Authority.	Reference.
	40°-41° ° ′ ″	91°-92° ° ′ ″		
Canton	40 07 46.38	91 31 19.63	Miss. R. C	Rept. '88.
University	07 50.57	31 49.67	do	Rept. '84.
Congill	11 27.78	31 20.22	do	Do.
Fox River	21 34.82	35 20.87	do	Do.
Lagrange	02 46.88	29 58.45	do	Do.
	40°-41°	95°-96°		
Craig	40 13 00.05	95 22 43.21	Mo. R. C	Rept. '91.
Langdon	22 29.30	31 56.12	do	Do.
Napier	02 45.22	14 37.39	do	Do.

MISSOURI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			95°-96°				
	°	′	″	°	′	″		
shne	40	17	53.47	95	28	06.15	Mo. R. C	Rept. '91.
elps		26	57.68		31	07.44	do	Do.
	39°-40°			90°-91°				
rksville	39	22	24.42	90	54	37.25	Miss. R. C	Rept. '84.
ham		01	38.90		44	57.54	do	Do.
ox		05	44.76		45	39.42	do	Do.
Lean		25	08.24		59	16.52	do	Do.
tpeter		15	15.73		49	37.99	do	Do.
	39°-40°			91°-92°				
nnibal	39	41	19.73	91	19	23.43	do	Do.
Elevator, southeast gable		42	19.21		20	38.94	do	Rept. '88.
ather		47	20.42		26	15.86	do	Rept. '84.
uisiana		27	23.99		03	11.31	do	Do.
Northeast corner of high school building.		27	12.65		03	08.25	L. S	Final Rept.
Southeast corner of brick residence on northwest corner Noyes and Fourth streets.		27	15.20		03	07.40	do	Do.
Stone observing post in northwest corner of high school yard.		27	14.30		03	06.30	do	Do.
son		52	20.76		30	06.58	Miss. R. C	Rept. '84.
l House		36	28.96		12	53.24	do	Do.
t River		28	07.58		04	15.33	do	Do.
	39°-40°			94°-95°				
azonia	39	53	21.07	94	53	54.10	Mo. R. C	Bull. 122.
ls		36	55.15		59	18.61	do	Do.
an		27	41.08		58	00.81	do	Do
ependence court-house		05	37.68		24	56.36	C. & G. S	
isas City:								
St. Patrick's church spire		06	08.04		35	19.19	do	
Transit								
nmoor		38	55.29		56	01.70	Mo. R. C	Do.
g Knob		43	06.93		51	35.96	do	Do.
se		29	58.30		59	39.89	do	Do.
Joe		48	31.34		52	11.90	do	Do.
nna		27	37.49		04	47.07	G. S	Do.
stport, college spire		04	06.47		35	18.31	C. & G. S	
	39°-40°			95°-96°				
est City	39	58	27.88	95	10	54.30	Mo. R. C	Do.
don		33	22.79		01	57.13	do	Do.
laway		54	55.71		01	28.70	do	Do.
ne		55	18.39		07	33.29	do	Do.
	38°-39°			90°-91°				
wise	38	54	59.25	90	16	05.50	Miss. R. C	Rept. '84.
key		05	12.82		12	48.87	do	Do.
ar		09	39.78		18	19.70	do	Do.
rell		00	26.00		04	54.83	do	Do.
t base		56	43.38		25	43.16	do	Do.
ele		54	33.62		18	58.00	do	Do.
der		30	39.64		17	32.83	do	Do.
eman		51	29.42		09	02.01	do	Do.
leck		28	12.42		55	24.10	C. & G. S	
culaneum		15	16.55		22	17.54	Miss. R. C	Do.
ne asylum		36	13.99		16	45.87	do	Do.
ch		24	32.46		43	59.70	C. & G. S	
nolia		02	42.54		08	40.13	Miss. R. C	Do.
ramee		24	23.78		19	36.79	do	Do.
souri River		48	39.97		07	49.21	do	Do.
holson		54	00.65		13	09.85	do	Do.
erson		27	57.41		31	59.53	C. & G. S	
age		55	10.84		20	37.98	Miss. R. C	Do.
rie		55	47.08		22	33.65	do	Do.
inson		45	30.68		11	18.10	do	Do.
Louis, Washington University		38	03.00		12	17.00	C. & G. S	
ley		50	48.33		07	22.12	Miss. R. C	Do.
dpipe		40	13.59		12	31.51	do	Do.
ng		52	57.31		11	50.73	do	Do.
phur Springs		19	41.09		22	31.84	do	Do.
rapin		48	04.79		08	59.63	do	Do.
n Hollow		27	05.35		17	37.08	do	Do.
kins		52	05.69		10	38.65	do	Do.
per		54	27.33		14	29.76	do	Do.
t base		56	14.28		26	58.85	do	Do.
field		59	18.39		44	19.22	do	Do.
	38°-39°			91°-92°				
bs	38	26	22.93	91	16	09.42	C. & G. S	
er		27	01.78		35	48.40	do	
rs		27	51.82		03	45.43	do	

MISSOURI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			91°-92°				
	°	′	″	°	′	″		
Pilot	38	20	15.99	91	47	55.15	C. & G. S	
Winter		27	46.12		26	02.37	do	
	38°-39°			92°-93°				
Hughes	38	26	01.36	92	55	50.61	do	
Wright		46	01.63		22	28.27	Mo. R. C	Bull. 122.
	38°-39°			93°-94°				
Caldwell	38	34	10.21	93	45	21.08	C. & G. S	
Cook Knob, pole in cupola in Cook's ice house.		52	02.06		31	30.45	do	
Hazel Hill		53	46.08		45	05.57	do	
Heard		43	01.28		12	24.88	do	
High Point Tebo		34	39.15		34	18.80	do	
Kendrick		39	43 83		25	57.98	do	
Knob Noster		46	40.35		33	05.70	do	
Lamonte, Campbellite church spire		46	44.25		25	22.98	do	
Normal		45	37.89		44	15.08	do	
Schnackenburg		29	56.63		11	26.18	do	
Sedalia, spire		42	26.77		13	36.00	do	
	38°-39°			94°-95°				
Baker, Kingsville	38	45	41.91	94	04	11.78	do	
Belton, South Methodist church spire		48	37.64		31	48.65	do	
Bowler		53	20.98		23	38.30	do	
Butler, barn cupola		46	51.42		25	59.85	do	
Berry, Belton		49	18.89		33	32.45	do	
Chapel Hill		54	52.14		03	27.27	do	
Fulton, Harrisonville		38	48.46		18	33.07	do	
Hutton Mound		32	56.24		10	48.82	do	
North Mound		20	51.45		17	13.20	G. S	Do.
Thornton		50	10.25		14	45.83	do	Do.
Corner Ts. 42 and 43, State line		28	43.66		36	44.57	do	Do.
Corner Ts. 40 and 41, Rs. 30 and 31		18	29.52		17	28.44	do	Do.
Corner Ts. 19 and 20, State line		20	47.52		36	45.42	do	Do.
Corner Ts. 17 and 18, State line		31	11.86		36	42.39	do	Do.
	37°-38°			89°-90°				
Backbone	37	44	48.74	89	39	53.09	Miss. R. C	Rept. '84.
Bowles		01	02.61		12	31.18	do	Do.
Cape Girardeau		18	27.01		31	08.86	do	Rept. '88.
Normal school		18	45.14		31	53.17	do	Do.
Cape Lecroix		14	53.51		28	05.76	do	Rept. '84.
Commerce		08	27.52		28	13.19	do	Do.
Floral		20	50.38		28	25.53	do	Do.
Grand Chain		13	02.59		28	27.61	do	Do.
Hofner		10	05.44		27	06.25	do	Do.
Indian Creek		30	59.60		30	24.06	do	Do.
Killion		48	10.73		47	27.73	do	Do.
Lower base		49	28.52		43	34.53	do	Do.
Missouri Sister		04	41.99		17	00.56	do	Do.
Moccasin Springs		26	28.54		27	13.57	do	Do.
North base		14	26.69		27	49.10	do	Do.
Rowse		03	34.67		15	27.87	do	Do.
Rozier		51	50.03		54	54.85	do	Do.
Silica		36	41.72		31	11.11	do	Do.
South base		13	49.17		28	07.25	do	Do.
Taylor		02	51.93		14	15.28	do	Do.
Uncle Joe		11	51.36		28	07.18	do	Do.
Upper base		50	40.41		45	12.02	do	Do.
Vause		54	48.43		59	20.73	do	Do.
	37°-38°			90°-91°				
St. Genevieve, church spire	37	58	45.02	90	02	49.75	do	Rept. '88.
Bolivar:	37°-38°			93°-94°				
Astronomical pier	37	36	35.22	93	24	47.68	G. S	Bull. 49.
Court-house dome		36	53.38		24	38.00	do	Do.
Pinnacle of schoolhouse		37	01.87		24	47.75	do	Do.
Methodist church spire		36	58.28		24	34.33	do	Do.
Southwest pinnacle Southwest Baptist College.		36	31.34		24	44.78	do	Do.
North Springfield:								
Astronomical pier		13	15.96		17	17.58	do	Do.
Ozark Hotel, flagstaff		13	51.56		17	10.69	do	Do.
Waterworks, flagstaff		14	03.26		17	35.36	do	Do.
Catholic church spire		13	42.01		17	05.25	do	Do.
Drury College chapel, spire		13	06.60		17	16.74	do	Do.
Center sec. 13, T. 29 N., R. 22 W		13	10.16		17	08.59	do	Do.
SW. corner sec. 7, T. 29 N., R. 21 W		13	35.95		16	34.74	do	Do.
SW. corner T. 30 N., R. 21 W		16	30.65		17	50.62	do	Do.
¼ sec. corner W. side of sec. 1, T. 29 N., R. 22 W.		16	14.32		17	34.33	do	Do.
SW. corner sec. 1, T. 33 N., R. 23 W		36	47.93		24	44.95	do	Do.

MISSOURI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	37°-38°			93°-94°				
	°	'	"	°	'	"		
corner T. 33 N., R. 23 W	37	37	38.25	93	23	35.02	G. S	Bull. 49.
corner on S. side sec. 12, T. 33 N., 23 W.		36	48.25		25	31.45	do	Do.
	36°-37°			92°-93°				
lar	36	33	32.76	92	58	48.69	do	Bull. 122.
mmond		45	37.92		59	59.53	do	Do.
	36°-37°			93°-94°				
id	36	39	13.80	93	17	45.27	do	Do.
tterfield		43	43.96		54	48.91	do	Do.
hmer		39	56.00		42	32.43	do	Do.
ot Knob		32	46.34		32	46.49	do	Do.
out		36	34.49		08	47.74	do	Do.

NORTH DAKOTA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	48°-49°			102°-103°				
	°	'	"	°	'	"		
w Flies High	48	02	19.38	102	41	31.33	Mo. R. C	Rept. '91.
Horn		04	15.94		44	52.26	do	Do.
nnell		10	27.76		57	18.59	do	Do.
e Butte		05	24.41		52	40.07	do	Do.
ny Hill		02	54.45		34	58.63	do	Do.
awberry		10	00.23		53	15.92	do	Do.
ite Earth		07	44.12		40	43.08	do	Do.
	48°-49°			103°-104°				
Lands	48	03	27.61	103	27	15.48	do	Do.
ord		01	01.49		58	03.31	do	Do.
rst		03	27.28		32	06.26	do	Do.
Hill		04	35.48		12	47.48	do	Do.
es		02	00.86		34	53.87	do	Do.
is		04	26.78		21	12.67	do	Do.
s Cut		06	00.05		44	57.51	do	Do.
on		09	38.38		12	56.24	do	Do.
rvation		00	05.75		47	25.34	do	Do.
		05	21.90		37	36.16	do	Do.
cco		06	46.02		03	57.17	do	Do.
ton		02	16.67		53	53.54	do	Do.
ston		09	19.57		34	47.87	do	Do.
	47°-48°			100°-101°				
on	47	09	08.80	100	52	19.96	do	Do.
re Butte		03	00.07		56	09.54	do	Do.
burn		18	04.45		59	39.14	do	Do.
an		00	45.43		49	25.10	do	Do.
	47°-48°			101°-102°				
bold	47	33	40.56	101	49	39.49	do	Do.
pewa		33	06.02		40	32.98	do	Do.
Harbor		29	51.23		21	16.24	do	Do.
		30	16.36		41	26.65	do	Do.
nuel		31	21.44		35	06.96	do	Do.
e meridian		29	39.66		46	46.49	do	Do.
ock		25	00.43		25	41.67	do	Do.
man		18	33.22		26	22.75	do	Do.
lquist		20	36.06		18	25.19	do	Do.
lan Lake		14	55.88		08	38.54	do	Do.
h		12	56.94		02	49.83	do	Do.
nson		32	12.06		21	53.01	do	Do.
ton		16	24.60		22	44.04	do	Do.
enson		35	46.98		27	08.57	do	Do.
sherm		18	46.31		16	32.32	do	Do.
dow		29	01.42		28	44.72	do	Do.
	47°-48°			102°-103°				
n	47	30	17.60	102	02	55.77	do	Dc.
n		33	39.64		11	37.30	do	Do.
pendence		43	12.26		20	25.79	do	Do.
an Creek		45	33.30		33	30.34	do	Do.
e River		58	29.89		32	40.59	do	Do.
le Missouri		37	21.25		18	29.59	do	Do.
eury		44	32.80		29	12.89	do	Do.
ion		38	09.18		13	35.72	do	Do.
Ridge		52	14.17		41	47.32	do	Do.
le Mountain		51	19.75		40	27.67	do	Do.
ia		35	11.70		01	36.71	do	Do.
nd Ridge		50	12.49		31	00.20	do	Do.
		45	58.77		14	55.11	do	Do.

NORTH DAKOTA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
		47°-48°			103°-104°			
	°	′	″	°	′	″		
East base	47	59	49,98	103	56	52.94	Mo. R. C	Rept. '91.
Glass Bluff		57	01.14		55	45.40	do	Do.
Lagoon		58	47.17		28	37.08	do	Do.
Plum		59	43.48		21	53.65	do	Do.
West base		59	36.26		59	39.28	do	Do.
		46°-47°			100°-101°			
Battle Creek	46	08	44.72	100	39	07.00	do	Do.
Beaver Creek		17	08.40		31	30.62	do	Do.
Bismarck		49	12.84		45	08.11	do	Do.
Cannon Ball		23	55.25		38	19.27	do	Do.
Cathead		06	52.45		32	43.38	do	Do.
Fort Abraham Lincoln		46	10.00		50	57.00	Engr. Corps	Rept. '75.
Fort Rice		31	47.13		41	12.47	Mo. R. C	Rept. '91.
Fort Yates		05	59.44		38	07.42	do	Do.
Gayton		23	44.04		31	34.64	do	Do.
Givens		19	54.15		34	54.54	do	Do.
Glencoe		36	15.59		30	05.23	do	Do.
Harmon		58	40.13		57	15.11	do	Do.
Kayhall		44	03.89		40	33.96	do	Do.
Lincoln		46	12.23		51	03.22	do	Do.
Little Beaver		12	11.61		32	44.64	do	Do.
Little Hart		41	56.32		49	09.74	do	Do.
Mandan		51	08.07		55	05.04	do	Do.
Marysville		51	06.89		48	06.99	do	Do.
McIntyre		28	27.70		32	11.73	do	Do.
McRay		00	54.01		30	40.28	do	Do.
North base		48	10.89		48	14.58	do	Do.
Riverside		37	22.72		43	54.03	do	Do.
South base		45	34.60		47	00.60	do	Do.
Sperry		57	05.97		52	19.87	do	Do.
Van Solen		16	03.91		37	28.84	do	Do.
Winona		03	55.20		33	02.12	do	Do.
		45°-46°			100°-101°			
Fire Heart	45	59	39.55	100	34	41.14	do	Do.

SOUTH DAKOTA.

Name.	Latitude.			Longitude.			Authority.	Reference.
		45°-46°			100°-101°			
	°	′	″	°	′	″		
Ashley	45	37	45.15	100	26	16.76	Mo. R. C	Rept. '91.
Aske		33	46.22		22	53.90	do	Do.
Bunker Hill		06	21.61		14	34.37	do	Do.
Bennett		24	00.83		13	28.60	do	Do.
Blue Blanket		29	20.96		24	48.56	do	Do.
Blume		41	19.45		20	39.18	do	Do.
Box Elder		46	05.12		24	20.98	do	Do.
Campbell		41	08.63		14	47.46	do	Do.
Charger		03	20.84		21	00.95	do	Do.
Curlew		25	18.25		20	20.10	do	Do.
Doerschlag		58	01.94		27	14.98	do	Do.
Fox Island		28	29.75		18	10.20	do	Do.
Grand River		32	47.94		29	49.28	do	Do.
Kirkland		46	07.63		17	31.17	do	Do.
La Grace		53	49.18		23	27.76	do	Do.
Le Beau		19	28.54		17	22.61	do	Do.
Martin		55	43.20		32	47.35	do	Do.
McKinley		20	12.18		12	33.97	do	Do.
Roth		36	11.35		20	48.81	do	Do.
Scranton		14	36.96		13	32.42	do	Do.
St. Benedict		50	30.75		30	54.23	do	Do.
St. Stephen		12	46.10		19	01.65	do	Do.
		44°-45°			99°-100°			
Big Bend	44	13	46.16	99	37	31.62	do	Do.
Burnt Ridge		01	19.73		38	53.90	do	Do.
Cedar River		05	42.40		54	28.06	do	Do.
Chapelle Creek		16	29.61		54	01.86	do	Do.
Neck		08	15.29		35	36.32	do	Do.
Reynolds		10	45.69		46	09.14	do	Do.
Fort Thompson		06	02.46		26	44.92	do	Do.
Wolf Creek		01	57.01		18	10.48	do	Do.
		44°-45°			100°-101°			
Artichoke	44	50	27.93	100	21	19.01	do	Do.
Bad River		19	50.86		20	39.25	do	Do.
Barth		20	38.89		14	06.58	do	Do.

SOUTH DAKOTA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	44°-45°	100°-101°		
	° ′ ″	° ′ ″		
n Hill	44 25 39.58	100 27 23.68	Mo. R. C	Rept. '91.
etery	21 54.71	18 19.73	do	Do.
base	20 46.24	17 07.56	do	Do.
ank	46 43.75	25 45.40	do	Do.
Island	18 24.37	14 03.51	do	Do.
y	24 31.84	31 20.83	do	Do.
er	31 56.86	38 10.84	do	Do.
t City	59 15.11	18 07.48	do	Do.
	22 04.98	24 14.87	do	Do.
Bennett	41 38.25	41 46.38	do	Do.
George	14 21.71	02 04.22	do	Do.
m	29 28.34	29 24.58	do	Do.
es	18 05.28	02 08.00	do	Do.
elles	17 15.80	07 21.06	do	Do.
l	54 47.75	26 49.60	do	Do.
	20 15.48	08 45.29	do	Do.
e	22 50.28	20 26.44	do	Do.
an	19 32.50	18 01.60	do	Do.
Island	51 37.13	34 44.83	do	Do.
eau	19 26.16	05 16.95	do	Do.
esy	59 26.12	27 41.83	do	Do.
Butte	25 36.03	21 45.15	do	Do.
Hill	28 19.00	23 57.26	do	Do.
	41 54.74	29 06.48	do	Do.
base	21 14.97	19 47.76	do	Do.
	44°-45°	103°-104°		
utte	44 28 34.40	103 25 08.90	G. S	Bull. 122.
lo	18 12.90	05 26.80	do	Do.
	14 41.40	43 41.10	do	Do.
ood, *post-office*	22 34.00	43 18.60	L. S	Final Rept.
ng	05 20.30	03 32.30	G. S	Bull. 122.
ase	07 04.00	04 35.50	do	Do.
ll	09 53.80	06 20.10	do	Do.
ont	13 55.80	21 40.50	do	Do.
astronomical pier	04 45.24	12 59.28	do	Do.
s	03 07.10	14 16.50	do	Do.
ase	07 09.20	10 29.10	do	Do.
	06 53.70	14 12.00	do	Do.
	43°-44°	98°-99°		
	43 03 03.67	98 41 30.51	Mo. R. C	Rept. '91.
	18 02.59	51 58.75	do	Do.
d	08 43.72	37 39.33	do	Do.
ead	13 20.61	56 05.37	do	Do.
r	12 20.63	48 26.42	do	Do.
one	06 35.91	50 04.30	do	Do.
wan	03 52.46	29 21.42	do	Do.
	43°-44°	99°-100°		
Creek	43 59 10.55	99 28 45.86	do	Do.
	30 51.66	15 26.56	do	Do.
	56 24.00	19 42.32	do	Do.
	23 22.68	01 31.08	do	Do.
n	23 46.97	12 49.96	do	Do.
	47 06.18	27 05.15	do	Do.
rlain	47 23.66	19 17.70	do	Do.
	20 38.83	08 30.92	do	Do.
	27 52.74	19 56.52	do	Do.
okout	53 29.15	23 38.34	do	Do.
n	16 25.20	02 18.28	do	Do.
	26 46.83	07 42.65	do	Do.
	37 49.46	30 13.57	do	Do.
l	51 12.80	17 24.94	do	Do.
	31 47.39	24 37.69	do	Do.
	38 56.08	19 37.74	do	Do.
	43°-44°	102°-103°		
n Butte	43 55 07.00	102 58 42.50	G. S	Bull. 122.
	43°-44°	103°-104°		
	43 25 08.50	103 37 07.00	do	Do.
e	35 52.60	06 43.50	do	Do.
	45 56.44	36 17.30	Engr. Corps	Rept. '78.
	12 21.52	30 00.00	G. S	Bull. 122.
	30 51.00	22 03.40	do	Do.
Peak	51 59.60	31 27.30	do	Do.
e	00 04.50	16 02.70	do	Do.
	14 35.00	11 00.50	do	Do.

NEBRASKA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			96°-97°				
	°	'	"	°	'	"		
Baird	42	20	50.31	96	30	14.14	Mo. R. C	Rept. '91.
Blackbird		04	45.93		17	54.86	do	Do.
Emerson		30	04.95		28	06.87	do	Do.
Grant		10	32.11		00	33.26	do	Do.
Hall		36	42.45		30	25 34	do	Do.
Hedges		19	08.27		08	07.10	do	Do.
Ionia		39	19.78		46	02.25	do	Do.
Johnson		49	07.40		41	56.12	do	Do.
Round Cap		29	25.68		35	37.66	do	Do.
Ryan		42	14.28		53	02.74	do	Do.
Sargeants		24	31.50		21	04.78	do	Do.
Spirit Mound		52	26.44		57	31.90	do	Do.
Triloba		33	30.29		40	02.36	do	Do.
Westfield		41	13.31		33	21.77	do	Do.
Winnebago		15	57.93		22	27.17	do	Do.
	42°-43°			97°-98°				
Bon Homme	42	52	20.47	97	40	19.47	do	Do.
Bow Creek		46	03.82		07	32.98	do	Do.
Covell		49	53.77		56	31.20	do	Do.
Herrick		47	59.94		39	10.81	do	Do.
Kelley		47	50.98		57	26.60	do	Do.
Lakeport		53	20.24		33	06.55	do	Do.
Lost Creek		46	56.68		54	03.94	do	Do.
Niobrara		44	01.46		57	49.24	do	Do.
North base		47	54.41		55	33.18	do	Do.
Pit		47	50.29		31	02.84	do	Do.
Santee		47	58.11		47	10.61	do	Do.
Schmidt		48	15.38		19	48.03	do	Do.
South base		46	01.81		57	24.49	do	Do.
Springfield		53	07.24		50	34.33	do	Do.
Welby		55	57.63		19	00.38	do	Do.
	42°-43°			98°-99°				
Arneson	42	48	29.35	98	02	54.14	do	Do.
Bruce		53	45.01		24	37.50	do	Do.
Chouteau		52	17.12		08	37.97	do	Do.
Conger		55	50.48		13	42.09	do	Do.
Harrison		57	11.06		34	47.52	do	Do.
Ponca		46	47.56		12	29.06	do	Do.
Ward		45	07.05		06	25.15	do	Do.
	42°-43°			103°-104°				
Camp Robinson, flagstaff	42	39	48.33	103	27	45.00	Engr. Corps	Rept. '78.
	41°-42°			95°-96°				
Bellevue	41	09	47.79	95	53	57.06	do	Bull. 122.
Bluffs		14	32.44		50	35.43	do	Rept. '91.
Council		16	32.75		51	09.91	do	Do.
Crescent		21	09.58		52	16.73	do	Do.
Douglas		23	40.89		58	33.65	do	Do.
Henton		06	04.82		49	00.85	do	Do.
High School		15	36.11		56	38.14	do	Do.
Mormon		48	52.12		59	43.85	do	Do.
Omaha		16	50.46		57	33.27	do	Do.
Platte		02	08.56		53	55.42	Mo. R. C	Bull. 122.
Taylor		41	13.10		56	31.48	do	Rept. '91.
U. S. C. and G		15	33.94		56	37.22	do	Do.
	41°-42°			96°-97°				
Bench	41	33	11.12	96	07	45.58	do	Do.
Blair		31	05.32		07	05.09	do	Do.
East base		36	49.41		06	50.33	do	Do.
Herman		38	04.65		12	24.07	do	Do.
Sandig		56	32.87		14	31.41	do	Do.
Tekamah		46	16.27		13	34.99	do	Do.
West		36	49.19		09	40.18	do	Do
	41°-42°			100°-101°				
North Platte, astronomical monument.	41	08	18.33	100	45	53.14	Wheeler	Final Rept.
	41°-42°			102°-103°				
Fort Sidney, astronomical monument.	41	08	36.75	102	58	13.32	do	Do.
	41°-42°			103°-104°				
Bushnell, transit	41	13	54.00	103	52	56.25	C. & G. S	Rept. '84.
	40°-41°			95°-96°				
Arago	40	08	13.84	95	26	39.51	Mo. R. C	Rept. '91
Brownville		24	30.39		39	36.59	do	Do.
Calumet		53	40.80		53	21.02	do	Do.
City		36	32.01		47	59.14	do	Do.

NEBRASKA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			95°-96°				
	°	′	″	°	′	″		
ir	40	14	37.28	95	31	16.01	Mo. R. C	Rept. '91.
s		49	07.05		52	05.56	do	Do.
aha		01	08.48		20	59.11	do	Do.
		39	16.90		49	03.08	do	Do.
		28	10.98		42	11.39	do	Do.
eroin		16	44.45		34	18.72	do	Do.
	40°-41°			97°-98°				
line Kansas and Nebraska	40	00	12.52	97	55	54.66	G. S	Bull. 122.

KANSAS.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			94°-95°				
	°	′	″	°	′	″		
rson	39	41	56.86	94	58	59.13	Mo. R. C	Rept. '91.
onia		53	21.07		53	54.10	do	Do.
eavenworth		21	19.12		54	51.84	Engr. Corps	Do.
		50	46.35		59	45.32	Mo. R. C	Do.
		36	55.15		59	18.61	do	Do.
		27	41.08		58	00.81	do	Do.
oor		38	55.29		56	01.70	do	Do.
poo		24	22.13		58	25.79	do	Do.
Knob		43	06.93		51	35.96	do	Do.
		29	58.30		59	39.89	do	Do.
an		22	16.45		55	52.67	do	Do.
e		48	31.34		52	11.90	do	Do.
na		45	09.89		57	07.31	do	Do.
n		24	10.55		53	45.96	do	Do.
	39°-40°			95°-96°				
y	39	14	44.10	95	50	10.20	G. S	Bull. 122.
on		35	42.56		05	53.20	Mo. R. C	Rept. '91.
		22	20.01		33	13.35	G. S	Bull. 122.
		17	13.39		36	25.64	do	Do.
n		02	37.37		00	05.19	C. & G. S	Do.
City		58	27.88		10	54.30	Mo. R. C	Rept. '91.
		38	54.56		02	55.52	do	Do.
i		33	22.79		01	57.13	do	Do.
pton		00	06.17		24	21.74	G. S	Bull. 122.
t		53	26.71		10	04.96	Mo. R. C	Rept. '91.
n		11	54.86		34	40.64	G. S	Bull. 122.
		51	28.21		05	13.09	Mo. R. C	Rept. '91.
n		07	11.39		28	57.02	G. S	Bull. 122.
ay		54	55.71		01	28.70	Mo. R. C	Rept. '91.
lls		26	56.54		01	07.91	do	Do.
e		10	24.10		19	57.30	G. S	Bull. 122.
		06	56.78		20	53.40	do	Do.
		55	18.39		07	33.29	Mo. R. C	Rept. '91.
atomie		24	52.00		50	48.21	G. S	Bull. 122.
d		19	26.47		42	48.38	do	Do.
eek		15	56.26		31	17.35	do	Do.
erhorn		13	57.05		41	41.87	do	Do.
		31	34.23		06	02.24	Mo. R. C	Rept. '91.
		21	19.29		57	35.68	G. S	Bull. 122.
Cloud		57	39.99		16	25.02	Mo. R. Co	Rept. '91.
ll		05	02.12		12	35.59	G. S	Bull. 122.
er sec. 21, T. 7, R. 14		25	15.38		50	54.35	do	Do.
ner sec. 1, T. 11, R. 17		07	00.46		28	59.40	do	Do.
ner sec. 15, T. 12, R. 18		00	06.13		24	33.79	do	Do.
ner sec. 25, T. 9, R. 15		13	56.07		42	00.24	do	Do.
ner sec. 26, T. 8, R. 15		19	34.45		43	07.45	do	Do.
ner sec. 27, T. 9, R. 14		14	47.01		49	55.40	do	Do.
ier sec. 19, T. 10, R. 19		10	25.77		19	43.14	do	Do.
ier sec. 7, T. 11, R. 19		07	03.40		20	42.15	do	Do.
ier sec. 6, T. 12, R. 21		02	42.60		00	03.84	do	Do.
ner sec. 11, T. 9, R. 16		17	23.86		36	26.06	do	Do.
ner sec. 15, T. 8, R. 13		21	45.40		57	36.61	do	Do.
er sec. 16, T. 9, R. 17		16	05.63		30	57.47	do	Do.
er sec. 20, T. 11, R. 20		04	54.57		12	21.73	do	Do.
er sec. 7, T. 8, R. 17		22	12.42		33	12.80	do	Do.
orner sec. 12, T. 10, R. 16		11	44.71		34	46.93	do	Do.
	39°-40°			96°-97°				
	39	29	42.52	96	19	07.22	do	Do.
		28	48.46		26	44.12	do	Do.
ville		22	53.20		47	19.91	do	Do.
e		22	30.40		20	48.35	do	Do.
		26	19.60		32	45.05	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			96°-97°				
	°	′	″	°	′	″		
Randolph	39	32	02.03	96	44	44.33	G. S	Bull. 122.
Springside		32	55.57		30	28.01	do	Do.
St. Marys		16	31.60		06	15.10	do	Do.
Stockdale		20	44.26		32	01.20	do	Do.
SE. corner sec. 29, T. 6, R. 10		29	39.48		18	50.25	do	Do.
S. ½ sec. 17, T. 7, R. 8		26	12.84		32	51.35	do	Do.
SW. corner sec. 5, T. 8, R. 6		22	47.20		47	34.08	do	Do.
NE. corner sec. 6, T. 7, R. 9		28	48.65		26	40.66	do	Do.
N. ¼ corner sec. 7, T. 8, R. 10		22	41.20		20	32.57	do	Do.
N. ¼ corner sec. 15, T. 6, R. 6		32	17.77		44	44.30	do	Do.
NW. corner sec. 17, T. 9, R. 12		16	33.52		06	35.33	do	Do.
NW. corner sec. 21, T. 8, R. 8		20	59.72		32	16.32	do	Do.
	39°-40°			97°-98°				
Butler	39	15	25.88	97	15	33.67	do	Do.
Concordia		31	28.03		40	34.64	do	Do.
Frey		01	31.84		10	24.56	do	Do.
Jamestown		39	23.77		50	40.98	do	Do.
Minersville		40	10.09		41	58.48	do	Do.
Monument		13	33.24		30	05.41	do	Do.
Renshawe		33	37.45		11	47.30	do	Do.
Scottsville		32	26.99		57	22.31	do	Do.
Sulphur Springs		24	36.77		30	42.37	do	Do.
Table Mound		18	44.74		16	36.81	do	Do.
Thompson		04	19.49		49	45.44	C. & G. S	
Vine Creek		06	11.06		23	23.18	do	
Wayne		41	45.81		30	20.34	G. S	Do.
Wilmer		07	20.93		02	22.80	do	Do.
Center corner sec. 11, T. 12, R. 2		01	31.95		10	33.73	do	Do.
NW. corner sec. 13, T. 11, R. 1		06	15.63		23	23.79	do	Do.
SE. corner sec. 1, T. 11, R. 3		07	10.80		02	13.08	do	Do.
W. corner sec. 36, T. 9, R. 2 W		13	27.80		30	12.60	do	Do.
One-fourth corner secs. 24 and 19, T. 9, Rs. 1 and 2 E.		15	27.02		15	32.88	do	Do.
SE. corner sec. 35, T. 8, R. 1 E		18	29.10		16	36.70	do	Do.
S. ¼ corner sec. 26, T. 7, R. 2		24	35.86		30	43.88	do	Do.
N. ¼ corner sec. 20, T. 6, R. 3		31	34.49		40	34.29	do	Do.
S. ¼ corner sec. 11, T. 6, R. 6		32	24.73		57	25.56	do	Do.
E. corner sec. 11, T. 6, R. 6		32	38.69		09	16.32	do	Do.
S. ¼ corner sec. 35, T. 4, R. 5		39	17.65		50	50.43	do	Do.
S. ¼ corner sec. 30, T. 4, R. 3		40	10.17		41	50.37	do	Do.
NE. corner sec. 23, T. 4, R. 2 W		41	59.00		29	46.70	do	Do.
	39°-40°			98°-99°				
Blue Hill	39	20	34.43	98	19	01.13	do	Do.
Cemetery		35	51.53		10	25.06	do	Do.
Church		20	52.77		06	06.93	do	Do.
Hardilee		50	57.55		57	08.13	do	Do.
Lawrence Creek		31	17.82		51	28.82	do	Do.
Lincoln		05	34.63		05	56.86	C. & G. S	
Meade Ranch or Tree Will		13	32.79		32	31.61	do	
Old well		36	47.61		34	00.86	G. S	Do.
Point [illegible] Hill		44	21.20		05	42.48	do	Do.
School		39	23.13		42	38.01	do	Do.
Tipton		21	38.54		31	57.62	do	Do.
Waldo		10	00.77		49	52.37	C. & G. S	
Corner secs. 15, 16, 21, 22, T. 8, R. 7		21	04.73		05	50.81	G. S	Do.
E. ¼ corner sec. 15, T. 8, R. 11		21	39.38		31	38.08	do	Do.
W. ¼ corner sec. 23, T. 6, R. 14		31	09.68		51	32.13	do	Do.
SW. corner sec. 24, T. 5, R. 8		35	51.40		10	32.90	do	Do.
SE. corner sec. 16, T. 5, R. 11		36	44.32		33	40.50	do	Do.
N. ¼ corner sec. 8, T. 4, R. 7		44	32.04		05	47.87	do	Do.
W. ¼ corner sec. 30, T. 2, R. 14		51	06.93		57	15.75	do	Do.
	39°-40°			99°-100°				
Blue Mound	39	50	17.51	99	09	21.08	do	Do.
Densmore		35	22.38		41	51.48	do	Do.
Engstrom		34	43.59		00	06.57	do	Do.
Plaster Mound		46	18.67		30	21.19	do	Do.
Rock Mound		35	41.72		28	22.30	do	Do.
Stahl		44	00.81		49	08.34	do	Do.
Twin Mound		36	52.73		18	49.82	do	Do.
Windmill		33	02.28		54	10.34	do	Do.
N. ¼ corner sec. 34, T. 5, R. 15		35	01.40		00	08.34	do	Do.
NW. corner sec. 28, T. 5, R. 19		35	52.18		28	41.34	do	Do.
S. ¼ corner sec. 14, T. 5, R. 18		36	44.73		19	06.61	do	Do.
SE. corner sec. 5, T. 4, R. 22		43	38.57		48	55.11	do	Do.
N. ¼ corner sec. 32, T. 2, R. 16		50	39.66		09	04.78	do	Do.
	39°-40°			100°-101°				
Lenora	39	34	40.17	100	02	06.47	do	Do.
Wakeman		42	06.15		00	41.09	do	Do.
SW. corner sec. 33, T. 5, R. 24		34	05.50		02	23.00	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			94°-95°				
	°	′	″	°	′	″		
n	38	28	52.14	94	41	24.12	G. S	Bull. 122.
a, Methodist Episcopal church		57	49.10		44	20.00	do	Do.
Mound		30	30.94		36	54.35	do	Do.
ok		20	49.60		56	26.04	do	Do.
atomie, insane asylum		30	50.86		56	19.64	do	Do.
ed Mound		20	00.55		37	15.90	do	Do.
r Ts. 42 and 43, State line		28	43.66		36	44.57	do	Do.
r Ts. 40 and 41, Rs. 30 and 31		18	29.52		17	28.44	do	Do.
r Ts. 19 and 20, Rs. 22 and 23		20	48.72		55	02.97	do	Do.
r Ts. 19 and 20, State line		20	47.52		36	45.42	do	Do.
r Ts. 18 and 19, Rs. 24 and 25		26	02.63		41	43.13	do	Do.
r Ts. 17 and 18, Rs. 22 and 23		31	16.29		55	03.33	do	Do.
r Ts. 17 and 18, State line		31	11.86		36	42.39	do	Do.
	38°-39°			95°-96°				
	38	23	26.62	95	45	13.55	do	Do.
Iound		54	20.72		10	53.95	do	Do.
t		25	10.89		56	56.69	do	Do.
		22	48.40		38	11.72	do	Do.
ld, cross on church		23	13.58		27	09.65	do	Do.
e		27	26.86		46	25.60	do	Do.
nce University		57	30.48		14	36.32	do	Do.
s		27	15.04		27	30.12	do	Do.
ond, cupola of church		24	14.64		15	10.71	do	Do.
Iound		20	09.52		31	10.36	do	Do.
		30	28.72		40	19.64	do	Do.
Dutch college		22	00.30		13	00.18	do	Do.
choolhouse		25	07.59		51	29.45	do	Do.
		30	37.34		08	50.00	do	Do.
		23	57.08		03	51.80	do	Do.
ner sec. 36, T. 12, R. 19		57	30.06		14	28.13	do	Do.
rner sec. 22, T. 13, R. 20		54	00.74		11	08.03	do	Do.
Ts. 20 and 21, Rs. 19 and 20		15	39.10		14	54.33	do	Do.
Ts. 19 and 20, Rs. 19 and 20		20	52.61		14	53.47	do	Do.
Ts. 19 and 20, Rs. 16 and 17		20	53.15		34	53.15	do	Do.
Ts. 19 and 20, Rs. 14 and 15		20	51.74		48	07.69	do	Do.
Ts. 18 and 19, Rs. 17 and 18		26	06.60		28	14.58	do	Do.
Ts. 18 and 19, Rs. 14 and 15		26	05.34		48	06.91	do	Do.
Ts 18 and 19, Rs. 13 and 14		26	05.58		54	45.04	do	Do.
Ts. 17 and 18, Rs. 15 and 16		31	23.42		41	29.02	do	Do.
Ts. 17 and 18, Rs. 20 and 21		31	19.21		08	15.30	do	Do.
	38°-39°			96°-97°				
	38	23	52.41	96	28	21.28	do	Do.
anch		26	28.24		37	08.25	do	Do.
Mound		21	10.91		04	08.52	do	Do.
ood Falls, cupola of court-		22	18.47		32	28.30	do	Do.
, cupola of State normal		24	50.96		10	47.52	do	Do.
		15	57.32		54	53.86	do	Do.
Iound		18	57.82		24	11.58	do	Do.
		16	12.26		40	49.00	do	Do.
		10	30.13		53	46.84	do	Do.
		30	34.76		01	43.20	do	Do.
		09	13.46		59	58.46	do	Do.
		28	48.56		18	08.04	do	Do.
		19	34.46		37	38.01	do	Do.
s		21	52.57		43	56.30	do	Do.
's. 20 and 21, Rs. 5 and 6		15	45.68		49	07.73	do	Do.
's. 20 and 21, Rs. 6 and 7		15	45.39		42	29.86	do	Do.
's. 17 and 18, Rs. 12 and 13		31	21.70		01	24.07	do	Do.
's. 18 and 19, Rs. 7 and 8		26	11.61		35	50.45	do	Do.
's. 19 and 20, Rs. 6 and 7		20	57.83		42	30.25	do	Do.
's. 19 and 20, Rs. 12 and 13		20	54.26		01	25.50	do	Do.
s. 19 and 20, Rs. 7 and 8		20	57.74		35	52.40	do	Do.
s. 20 and 21, Rs. 4 and 5		15	45.45		55	45.11	do	Do.
's. 17 and 18, Rs. 8 and 9		31	23.60		27	51.51	do	Do.
	38°-39°			97°-98°				
	38	10	32.99	97	16	03.24	do	Do.
ttle		08	52.10		33	43.00	do	Do.
		18	28.69		10	06.06	do	Do.
		04	24.78		39	51.21	do	Do.
		14	27.16		01	23.46	do	Do.
		08	30.86		25	38.62	do	Do.
nd		48	34.58		30	42.85	C. & G. S	
		08	39.43		47	17.01	G. S	Do.
		06	44.73		11	58.24	do	Do.
		02	58.56		20	40.06	do	Do.
		10	09.10		20	09.84	do	Do.
		08	30.50		29	40.05	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			97°-98°				
	°	′	″	°	′	″		
Sand Hill	38	09	38.57	97	56	47.08	G. S	Bull. 123.
Sheep Ranch		04	10.15		48	42.82	do	Do.
Walton		07	58.43		14	02.11	do	Do.
SE. corner sec. 36, T. 21, R. 1 E.		10	27.58		15	44.98	do	Do.
SE. corner sec. 36, T. 22, R. 1 E		05	10.40		15	46.12	do	Do.
SE. corner sec. 8, T. 22, R. 2		08	40.37		33	17.20	do	Do.
SW. corner sec. 8, T. 22, R. 4		08	39.22		47	35.89	do	Do.
SW. corner sec. 4, T. 23, R. 3 W		04	18.44		39	50.32	do	Do.
SW. corner sec. 13, T. 21, R. 2 E		13	04.86		10	10.83	do	Do.
SW. corner sec. 33, T. 21, R. 1 E		10	24.77		20	09.69	do	Do.
Township corner		05	12.73		15	46.66	do	Do.
NE. corner sec. 13, T. 23, R. 5 W		08	24.96		48	38.43	do	Do.
NE. corner sec. 16, T. 22, R. 1 W		08	39.46		25	33.46	do	Do.
NE. corner sec. 16, T. 23, R. 1 E		02	57.72		20	38.70	do	Do.
	38°-39°			98°-99°				
Ackerman	38	07	21.59	98	50	45.32	do	Do.
Allon		49	41.74		52	20.46	C. & G. S	
Bunker Hill		52	20.26		42	18.52	do	
Cactus		24	17.00		52	06.63	G. S	Do.
Drifting Sand		09	44.89		26	51.08	do	Do.
Ellsworth		43	48.00		13	35.00	C. & G. S	
Golden Belt		58	48.25		18	25.72	do	
Heath		50	45.10		02	59.70	do	
Lyons		19	51.93		06	43.70	G. S	Do.
Millet		18	01.57		21	23.26	do	Do.
Mound		13	52.48		47	04.24	do	Do.
Pasture		22	23.95		39	33.57	do	Do.
Raymond		17	36.29		24	12.15	do	Do.
Sterling		13	14.64		12	24.26	do	Do.
Two		03	21.56		01	27.49	do	Do.
Wilson		51	55.97		29	18.17	C. & G. S	
SW. corner sec. 16, T. 21, R. 8		13	00.15		12	53.68	G. S	Do.
SW. corner sec. 23, T. 20, R. 10		17	23.38		24	20.49	do	Do.
SE. corner sec. 36, T. 20, R. 12		15	37.92		35	22.11	do	Do.
NE. corner sec. 16, T. 19, R. 14		24	17.21		51	56.28	do	Do.
NE. corner sec. 18, T. 21, R. 13		13	54.42		47	01.07	do	Do.
NE. corner sec. 12, T. 20, R. 8		19	57.41		08	43.50	do	Do.
NW. corner sec. 8, T. 22, R. 10		10	22.12		27	06.43	do	Do.
NW. corner sec. 28, T. 19, R. 12		22	33.39		39	46.92	do	Do.
NW. corner sec. 18, T. 23. R. 7		03	24.26		01	49.70	do	Do.
	38°-39°			99°-100°				
Blue Hill	38	59	01.93	99	05	58.46	C. & G. S	
Burdette		08	43.23		32	46.31	G. S	Do.
Cheese Factory		01	43.15		36	42.51	do	Do.
Dugout		15	21.16		13	44.80	do	Do.
Fair Mount		40	35.70		00	17.42	do	Do.
Frank		12	19.09		43	16.18	do	Do.
Garfield		06	29.63		13	56.68	do	Do.
Hays		54	56.66		16	16.86	C. & G. S	
Larned		07	55.74		03	52.94	G. S	Do.
La Crosse		35	42.96		16	10.83	C. & G. S	
Last Chance		03	40.85		36	12.94	G. S	Do.
Orwell		01	25.08		48	16.96	do	Do.
Pawnee		18	05.09		01	25.25	do	Do.
Quarry		15	19.81		25	18.54	do	Do.
SE. corner sec. 22, T. 21, R. 22		12	13.49		42	58.18	do	Do.
SE. corner sec. 15, T. 22, R. 16		07	49.36		03	27.13	do	Do
SE. corner sec. 29, T. 23, R. 21		01	42.99		38	30.01	do	Do.
SE. corner sec. 25, T. 23, R. 23		01	16.87		47	17.98	do	Do.
SW. corner sec. 14, T. 23, R. 21		03	27.33		36	17.90	do	Do.
NW. corner sec. 19, T. 20, R. 15		18	15.26		01	53.60	do	Do.
NW. corner sec. 17, T. 22, R. 20		08	43.37		33	02.88	do	Do.
NW. corner sec. 5, T. 21, R. 19		15	42.82		25	26.48	do	Do.
NW. corner sec. 30, T. 22, R. 17		06	55.99		14	22.27	do	Do.
NW. corner sec. 6, T. 21, R. 17		15	38.22		14	01.82	do	Do.
	38°-39°			101°-102°				
Coyote	38	01	36.85	101	02	05.96	do	Do.
Lakin		00	38.35		14	06.41	do	Do.
NE. corner sec. 35, T. 22, R. 36		00	58.76		13	46.56	do	Do.
NW. corner sec. 27, T. 23, R. 34		01	58.62		02	47.72	do	Do.
Fort Scott:	37°-38°			94°-95°				
Standpipe	37	49	54.08	94	42	58.13	do	Bull. 48.
Spire on cupola of Central School		50	17.28		42	28.19	do	Do.
Spire of Congregational church		50	15.20		42	26.91	do	Do.
Flagstaff in national cemetery		49	21.14		41	33.04	do	Do.
Astronomical pier		50	25.76		42	26.75	do	Do.
SE. corner sec. 31, T. 25 S., R. 25 E., Bourbon County.		49	13.79		41	42.71	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	37°–38°			94°–95°				
	°	′	″	°	′	″		
rner S. side sec. 31, T. 25 S., R. Bourbon County.	37	49	13.73	94	42	15.84	G. S	Bull. 49.
ner T. 25 S., R. 25 E., Bourbon ty.		49	13.75		42	48.78	do	Do.
:	37°–38°			95°–96°				
e Baptist church	37	10	09.45	95	06	22.16	do	Do.
e of court-house		09	58.93		06	24.08	do	Do.
e Methodist church		10	13.24		06	32.11	do	Do.
e schoolhouse		10	09.00		06	48.64	do	Do.
ette County astronomical pier		09	59.81		06	24.66	do	Do.
ine house		09	58.80		06	28.66	do	Do.
ner T. 30 S., R. 21 E., Labette y.		12	33.38		09	26.37	do	Do.
ner T. 33 S., R. 21 E., Labette y.		11	41.00		09	26.31	do	Do.
s:	37°–38°			96°–97°				
e Methodist church	37	22	19.87	96	11	22.79	do	Do.
onomical pier		22	03.64		11	14.46	do	Do.
ner S. sec. 10, T. 31 S., R. 11 E., unty.		21	33.82		11	23.45	do	Do.
er T. 30 S., R. 11 E., Elk County		23	18.06		08	32.13	do	Do.
er sec. 10, T. 31 S., R. 11 E., Elk r.		21	33.89		10	49.67	do	Do.
ier sec. 10, T. 31 S., R. 11 E., Elk r.		21	33.83		11	55.21	do	Do.
	37°–38°			99°–100°				
w	37	59	06.27	99	50	00.11	do	Bull. 122.
		51	12.71		59	54.26	do	Do.
le		56	30.51		57	14.45	do	Do.
e (astronomic pier)		59	06.34		45	10.05	do	Bull. 70.
		47	44.38		51	43.91	do	Bull. 122.
er sec. 8, T. 26, R. 23		47	34.78		52	06.17	do	Do.
r sec. 21, T. 24, R. 24		56	29.98		57	14.34	do	Do.
r sec. 3, T. 24, R. 23		59	06.21		49	30.70	do	Do.
r sec. 29, T. 25, R. 22		51	15.57		45	06.54	do	Do.
r sec. 30, T. 25, R. 24		51	14.31		52	57.20	do	Do.
	37°–38°			100°–101°				
	37	52	33.13	100	52	48.00	do	Do.
		49	25.42		19	39.01	do	Do.
pipe		49	00.32		20	48.05	do	Do.
house		48	31.02		20	40.80	do	Do.
1		46	17.35		41	27.65	do	Do.
		46	35.40		02	33.52	do	Do.
ity:								
schoolhouse		58	19.70		52	23.70	do	Do.
schoolhouse		57	39.18		52	14.77	do	Do.
pipe		57	50.35		52	41.89	do	Do.
w		40	48.17		14	38.68	do	Do.
house		51	21.97		20	07.73	do	Do.
		43	53.57		28	27.30	do	Do.
		51	01.57		28	03.64	do	Do.
		58	23.46		45	28.05	do	Do.
		51	23.70		16	52.41	do	Do.
airie schoolhouse		50	26.24		15	47.05	do	Do.
		53	23.74		38	07.09	do	Do.
house		53	01.31		40	19.97	do	Do.
se, 4 miles east of Mans-		56	11.52		41	58.42	do	Do.
		51	51.54		06	58.89	do	Do.
sec. 23, T. 27, R. 27		40	42.46		14	26.80	do	Do.
sec. 36, T. 26, R. 31		44	03.73		39	10.82	do	Do.
sec. 27, T. 25, R. 27		50	27.35		15	45.94	do	Do.
r sec. 19, T. 25, R. 27		51	20.61		20	09.49	do	Do.
r sec. 31, T. 25, R. 27		49	36.18		20	09.60	do	Do.
r sec. 22, T. 25. R, 27		51	20.10		16	52.56	do	Do.
r sec. 8, T. 25, R. 30		54	01.44		38	42.51	do	Do.
r sec. 6, T. 27, R. 30		44	03.73		39	10.82	do	Do.
sec. 30, T. 25, R. 32		51	29.25		52	23.63	do	Do.
sec. 3, T. 27, R. 29		44	11.57		28	40.47	do	Do.
sec. 22, T. 26, R. 25		46	46.72		01	54.87	do	Do.
r sec. 19, T. 25, R. 25		52	09.59		06	59.15	do	Do.
sec. 18, T. 24, R. 31		58	25.98		45	17.15	do	Do.
sec. 26, T. 25, R. 29		50	56.11		27	49.80	do	Do.
	37°–38°			101°–102°				
	37	54	58.57	101	02	26.76	do	Do.
		47	48.35		23	38.21	do	Do.
hoolhouse		58	54.76		08	06.13	do	Do.
		55	17.46		22	32.83	do	Do.
ouse		53	21.06		22	03.49	do	Do.
		53	05.37		13	56.65	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	37°-38°			101°-102°				
	°	′	″	°	′	″		
Lakin schoolhouse	37	56	30.75	101	15	27.00	G. S	Bull. 122.
NW. corner sec. 11, T. 25, R. 36		54	00.98		14	53.67	do	Do.
NE. corner sec. 15, T. 24, R. 34		58	25.84		01	43.08	do	Do.
NW. corner sec. 15, T. 24, R. 34		58	25.27		02	49.03	do	Do.
W. ¼ corner sec. 34, T. 24, R. 37		55	17.81		22	32.94	do	Do.

MONTANA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	48°-49°			104°-105°				
	°	′	″	°	′	″		
Big Horn	48	06	26.66	104	23	40.17	Mo. R. C	Rept. '91.
Big Muddy		09	47.47		34	02.50	do	Do.
Boulder		04	35.98		31	44.79	do	Rept. '94.
Box Elder		10	33.79		48	22.05	do	Rept. '91.
Devil's Elbow		06	08.14		44	40.85	do	Do.
Lanark		06	16.91		13	52.58	do	Do.
Montana		01	47.75		03	08.55	do	Do.
Mortar Stone		04	04.97		57	13.97	do	Do.
St. Ange		02	06.68		18	58.33	do	Do.
	48°-49°			105°-106°				
Deer Tail	48	07	35.92	105	04	11.31	do	Do.
Elk River		00	25.69		46	55.42	do	Do.
Hopkins		02	08.68		38	43.35	do	Do.
Macon		08	19.77		29	42.52	do	Do.
Oswego		04	22.75		51	26.01	do	Do.
Poplar		08	59.28		14	09.51	do	Do.
Red Water		02	37.76		09	02.55	do	Do.
Santee		03	27.58		55	59.62	do	Do.
Spread Eagle		03	36.87		27	32.59	do	Do.
Wolf Point		06	26.05		41	55.68	do	Do.
	48°-49°			106°-107°				
Galpin	48	05	17.67	106	26	06.81	do	Do.
Knityre		03	33.98		09	22.09	do	Do.
Lennox		04	11.32		00	58.51	do	Do.
Milk River		01	48.31		18	48.58	do	Do.
Nassau		05	36.59		18	22.52	do	Do.
Peck		00	11.09		32	38.43	do	Do.
	48°-49°			109°-110°				
Bear Paw	48	09	00.00	109	38	58.00	G. S	Bull. 122.
	48°-49°			110°-111°				
Coal banks	48	02	03.88	110	15	33.74	Mo. R. C	Rept. '91.
Old		03	26.97		09	39.62	do	Do.
Recess		00	49.09		20	01.91	do	Do.
Sandy		00	38.09		04	48.12	do	Do.
Shanks		00	08.83		14	22.37	do	Do.
	48°-49°			111°-112°				
Sweet Grass	48	50	52.60	111	22	21.00	G. S	Bull. 122.
	47°-48°			104°-105°				
Cut-off	47	59	47.20	104	09	54.16	Mo. R. C	Rept. '91.
Ferry		58	33.35		04	24.47	do	Do.
	47°-48°			105°-106°				
Amelia Poe	47	59	00.40	105	58	22.00	do	Do.
	47°-48°			106°-107°				
Bone Bluffs	47	59	41.26	106	09	55.95	do	Do.
Double Hill		49	41.74		41	27.69	do	Do.
Dry Fork		56	41.03		22	37.37	do	Do.
Featherland		42	33.32		50	33.24	do	Rept. '94.
Five Pines		46	52.24		52	18.35	do	Rept. '91.
Hell Creek		39	47.17		53	31.71	do	Do.
Juniper		53	44.55		34	18.87	do	Do.
Last Pine		50	53.27		29	17.43	do	Do.
Norris		44	37.67		40	43.43	do	Rept. '94.
	47°-48°			107°-108°				
Above	47	32	03.84	107	54	20.64	do	Rept. '91
Ball Rock		39	29.88		30	57.03	do	Do.
Below		30	31.59		50	14.12	do	Do.
Cowboy		28	31.05		55	47.75	do	Do.
Cut-off		34	08.71		54	33.34	do	Do.
Dogtown		36	20.51		32	31.11	do	Do.
East base		38	18.80		39	18.11	do	Do.
Elk		36	16.75		44	01.10	do	Do.
Forgey		39	16.00		39	41.14	do	Do.
Gibson		38	11.41		12	31.98	do	Do.
Grizzly		41	58.88		00	13.20	do	Do.

MONTANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	47°-48°			107°-108°				
	°	′	″	°	′	″		
	47	35	59.26	107	40	47.11	Mo. R. C	Rept. '91.
		32	38.22		50	38.27	do	Do.
		35	08.16		56	40.76	do	Do.
Snow		38	34.53		08	20.67	do	Do.
Shell		29	50.20		55	29.51	do	Rept. '86.
		29	20.98		52	02.33	do	Do.
		26	20.74		54	16.60	do	Rept. '94.
Shell Cowboy		28	16.80		55	46.48	do	Rept. '86.
		30	44.69		48	31.92	do	Rept. '91.
		33	23.66		57	46.33	do	Do.
		30	04.46		55	30.78	do	Do.
ak		43	18.56		24	39.82	do	Do.
lack Feet		38	36.12		23	05.48	do	Do.
anyon		42	24.37		11	22.41	do	Do.
		33	08.75		43	45.43	do	Do.
		36	59.04		37	19.34	do	Rept. '94.
se		37	48.39		41	32.56	do	Rept. '91.
		34	06.26		47	01.22	do	Do.
s		29	35.23		52	08.60	do	Do.
	47°-48°			108°-109°				
	47	35	01.82	108	05	55.67	do	Do.
		36	25.62		38	57.90	do	Do.
l		36	28.04		24	43.91	do	Do.
		43	12.08		54	59.54	do	Do.
		36	01.95		36	05.20	do	Do.
		38	56.75		40	38.60	do	Do.
nd		37	59.82		44	08.36	do	Do.
astronomic monument		34	48.00		24	00.00	Engr. Corps	Rept. '76.
		33	33.51		21	15.46	Mo. R. C	Rept. '91.
nd		45	37.23		57	32.58	do	Do.
		37	30.45		29	27.15	do	Do.
		42	00.81		52	22.07	do	Do.
		44	34.39		51	10.03	do	Do.
		35	42.61		01	32.91	do	Do.
land		42	09.59		46	57.53	do	Do.
		38	06.92		36	04.82	do	Do.
		37	19.61		05	52.90	do	Do.
k		35	35.00		10	04.69	do	Do.
		46	18.05		54	36.27	do	Do.
		33	51.19		07	46.80	do	Do.
		34	40.37		25	48.83	do	Do.
		35	47.63		16	04.09	do	Do.
		40	03.27		48	54.73	do	Do.
oint		35	05.31		28	12.45	do	Do.
		35	30.56		20	19.07	do	Do.
nd		34	09.05		16	23.59	do	Do.
		33	51.08		12	31.44	do	Do.
		33	52.69		00	48.98	do	Do.
int		49	15.20		58	36.32	do	Do.
		40	24.04		44	17.96	do	Do.
	47°-48°			109°-110°				
	47	41	16.56	109	48	25.54	do	Do.
		44	33.20		28	43.77	do	Do.
		45	47.33		08	35.83	do	Do.
		46	33.61		15	42.08	do	Do.
ris		03	47.00		26	30.00	Engr. Corps	Rept. '76.
		46	25.29		35	22.22	Mo. R. C	Rept. '91.
		43	44.99		21	54.71	do	Do.
		42	35.84		27	45.47	do	Do.
		43	35.91		31	39.21	do	Do.
		45	22.32		31	02.96	do	Do.
		13	07.90		13	15.60	G. S	Bull. 122.
		42	32.35		37	48.91	Mo. R. C	Rept. '91.
e		47	45.88		19	42.25	do	Do.
		45	41.21		51	01.26	do	Do.
		48	14.73		57	00.84	do	Do.
		41	14.31		42	49.03	do	Do.
		43	06.51		44	54.96	do	Do.
		46	06.09		22	48.14	do	Do.
		44	04.21		54	17.48	do	Do.
		46	19.96		02	38.70	do	Do.
		48	43.10		04	14.66	do	Do.
		44	02.31		49	46.99	do	Do.
		44	48.93		42	20.15	do	Do.
		46	32.02		59	10.46	do	Do.
		48	32.66		11	49.10	do	Do.
	47°-48°			110°-111°				
	47	25	40.70	110	31	35.90	G. S	Bull. 122.
		48	46.57		41	58.56	Mo. R. C	Rept. '91.

MONTANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	47°-48°			110°-°111				
Benton—Continued.	°	′	″	°	′	″		
Flagstaff, Fort Benton	47	48	50.00	110	39	48.00	Mo. R. C	Rept. '86.
Hub		50	07.77		39	54.78	do	Do.
Black Bluff		54	14.75		26	45.31	do	Do.
Brule		51	12.81		30	24.63	do	Rept. '91.
Burned		57	21.22		03	37.90	do	Do.
Castle		53	35.28		02	53.16	do	Do.
Cherry		43	13.38		47	17.84	do	Do.
Citadel		50	32.65		02	30.41	do	Do.
Crocon		52	33.58		34	41.82	do	Do.
East base		50	40.25		40	04.27	do	Do.
Fort Benton		49	38.00		39	48.00	Engr. Corps	Rept. '76.
Flagstaff		49	03.97		39	49.88	Mo. R. C	Rept. '91.
Harvey		50	36.73		33	53.53	do	Do.
Highwood		39	23.28		52	42.02	do	Do.
Hub		50	22.02		39	56.05	do	Do.
Iron		59	10.69		08	35.41	do	Do.
Kipp		52	03.18		05	35.18	do	Do.
Labarge		49	22.72		04	55.60	do	Do.
Marias		56	22.17		29	10.45	do	Do.
Mound		58	47.44		17	50.70	do	Do.
Ridge		59	24.12		26	04.38	do	Do.
Shanks		59	54.58		14	21.10	do	Rept. '86.
Shonkin		49	46.05		36	51.86	do	Rept. '91.
Sheperd		34	56.62		56	19.23	do	Do.
Sidney		45	54.63		58	38.04	do	Do.
Tele		54	23.77		32	07.22	do	Do.
Teton		52	13.47		43	04.88	do	Do.
Three Islands		56	39.54		22	33.62	do	Do.
Tunis		48	21.61		49	09.03	do	Do.
Wellman		54	40.87		05	38.27	do	Do.
West base		50	11.78		42	22.60	do	Do.
White Cliffs		55	49.34		05	53.22	do	Do.
	47°-48°			111°-112°				
Antelope	47	26	31.90	111	25	39.49	do	Do.
Belt		31	56.14		01	44.37	do	Do.
Big Bend		21	56.84		16	47.17	do	Do.
Bromedy		32	02.94		08	14.02	do	Do.
Cascade		16	57.73		42	35.55	do	Do.
Craig		08	08.17		57	39.28	do	Do.
Divide		18	18.23		31	35.45	do	Do.
Earley		35	24.18		06	59.64	do	Do.
Epler		26	27.04		21	28.03	do	Do.
Fort Shaw		30	33.00		48	19.50	Engr. Corps	Rept. '76.
Great Falls		29	44.61		15	01.52	Mo. R. C	Rept. '91.
Hardy		13	01.29		48	39.11	do	Do.
Henry		30	35.42		11	24.85	do	Do.
Muddy Creek		21	32.05		35	28.17	do	Do.
North Great Falls		31	49.87		15	26.23	do	Do.
Portage		39	16.64		05	17.12	do	Do.
Porter		33	51.22		10	36.12	do	Do.
Sand Conlee		25	53.99		16	35.23	do	Do.
Sheep Creek		10	09.45		42	23.21	do	Do.
St. Clair		14	45.84		37	02.99	do	Do.
Stickney		06	53.30		51	11.28	do	Do.
Shaw		26	29.70		44	56.70	G. S	Bull. 122.
Sugarloaf		00	53.40		54	14.73	Mo. R. C	Rept. '91.
Sun River		28	44.79		21	13.92	do	Do.
Transfer		31	23.80		19	48.32	do	Do.
Ulm		26	23.11		31	04.52	do	Do.
Wagner		04	54.28		55	41.24	do	Do.
Wilson		24	03.17		24	39.61	do	Do.
	47°-48°			112°-113°				
Keep Cool	47	07	08.20	112	44	21.20	G. S	Bull. 122.
Rock Creek		03	28.37		00	32.99	Mo. R. C	Rept. '91.
Rocky		48	53.50		48	03.10	G. S	Bull. 122.
Wolf Creek		00	38.41		03	34.61	Mo. R. C	Rept. '91.
	47°-48°			113°-114°				
McDonald	47	23	11.00	113	55	18.00	G. S	Bull. 122.
	46°-47°			105°-106°				
Fort Keogh	46	23	11.65	105	56	53.08	Engr. Corps	Rept. '79.
	46°-47°			107°-108°				
East base (Custer Z. station)	46	07	55.70	107	31	00.30	G. S	Bull. 122.
Terry		10	36.20		36	12.00	do	Do.
West base		06	10.60		33	18.10	do	Do.
	46°-47°			109°-110°				
Big Snowy	46	45	12.30	109	18	48.80	do	Do.
	46°-47°			110°-111°				
Brewer Springs	46	32	50.00	110	55	40.00	Engr. Corps	Rept. '78.
Crazy		01	13.10		16	36.20	G. S	Bull. 122.

MONTANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	46°-47°			110°-111°				
	°	′	″	°	′	″		
Elk	46	27	17.60	110	45	12.30	G. S	Bull. 122.
Moss Agate Springs		23	40.00		53	30.00	Engr. Corps	Rept. '76.
Neihart		58	15.10		36	22.50	G. S	Bull. 122.
	46°-47°			111°-112°				
American	46	50	00.68	111	53	07.21	Mo. R. C	Rept. '91.
Beattie		00	30.20		27	08.39	do	Do.
Beaver Creek		29	06.98		34	59.09	do	Do.
B. T. Mountain		53	53.48		59	08.10	do	Do.
Blackwell		36	46.75		35	45.27	do	Do.
Boulder		17	46.80		54	14.00	do	Do.
Bridge		20	24.18		32	05.67	do	Do.
Camp Baker		40	44.00		11	00.00	Engr. Corps	Rept. '76.
Canyon Ferry		38	43.09		44	22.38	Mo. R. C	Rept. '91.
Carolus		05	41.54		21	58.72	do	Do.
Confederate		30	13.77		31	09.79	do	Do.
Degau		34	43.24		40	19.41	do	Do.
Deep Creek		18	38.94		26	28.25	do	Do.
Dougherty		09	55.63		28	40.36	do	Do.
Duck Creek		27	18.96		28	06.48	do	Do.
El Dorado		44	31.80		48	44.29	do	Do.
Toston		10	06.61		23	48.50	do	Do.
Fuller		41	10.76		45	20.00	do	Do.
Geary		33	12.86		32	12.82	do	Do.
Hilger		46	10.07		55	48.43	do	Do.
Hossfeld		15	42.71		30	19.67	do	Do.
Howard		12	42.93		30	34.69	do	Do.
Junction		01	03.34		30	31.21	G. S	Bull. 122.
Lone Bush		08	52.28		22	26.53	Mo. R. C	Rept. '91.
Magpie		02	59.68		22	22.11	do	Do.
Marks		24	21.71		26	35.96	do	Do.
Maxwell		40	25.96		40	00.33	do	Do.
Mitler		59	45.10		55	42.40	do	Do.
Ox Bow		57	33.39		59	28.12	do	Do.
Ox Bow (Moore Mountain)		55	54.80		44	01.10	do	Do.
Painted Rock		07	49.71		24	57.99	do	Do.
Pinnacle		05	36.80		24	12.72	do	Do.
Prickly Pear		43	11.57		53	26.59	do	Do.
Reed		25	58.97		33	54.40	do	Do.
Reeves		13	36.79		25	37.74	do	Do.
Sawyer		02	51.66		25	44.60	do	Do.
Squires		31	36.95		36	45.88	do	Do.
Stubbs		39	38.06		51	04.31	do	Do.
Willow Creek		56	23.28		53	00.14	do	Do.
	46°-47°			112°-113°				
Mitchell	46	58	56.00	112	16	54.00	G. S	Bull. 122.
Powell		21	07.30		58	48.60	do	Do.
	45°-46°			107°-108°				
Abbott (Abbott's Urn)	45	40	48.80	107	22	59.50	do	Do.
Custer		34	30.40		16	50.10	do	Do.
Far West		36	43.50		47	04.30	do	Do.
Little Horn		03	26.00		25	49.70	do	Do.
Mesa		49	37.50		50	50.30	do	Do.
Pine Ridge		59	14.60		39	34.70	do	Do.
Reno		11	08.30		26	42.70	do	Do.
Red Bluff		02	16.90		11	33.30	do	Do.
Rosebud		20	41.20		11	32.40	do	Do.
Rotten Grass		21	06.60		33	51.70	do	Do.
Ryan		54	22.10		27	07.00	do	Do
	45°-46°			108°-109°				
Absaroka	45	42	39.70	108	08	56.70	do	Do.
Billings		42	59.30		27	32.20	do	Do.
Boundary		31	13.70		35	48.50	do	Do.
Canyon		50	03.20		47	40.90	do	Do.
Mauvaise Terre		33	41.90		19	41.10	do	Do.
	45°-46°			109°-110°				
Granite	45	09	56.00	109	48	22.00	do	Do.
Shane		30	45.30		08	11.50	do	Do.
Stillwater		35	28.00		34	16.20	do	Do.
White Beaver		50	05.20		18	01.80	do	Do.
Wilson		51	48.10		39	10.10	do	Do.
	45°-46°			110°-111°				
Bozeman, Station X	45	41	15.30	110	59	19.20	Wheeler	Do.
Bridger Mountain		47	36.80		56	15.60	G. S	Do.
Electric Peak		00	27.04		50	15.05	do	Do.
Emigrant Peak		15	54.13		42	25.35	do	Do.
Fort Ellis, flagstaff		40	13.45		58	30.97	Wheeler	Do.
Grassy Knoll		41	42.64		59	00.18	G. S	Do.
Haystack		11	55.89		13	17.58	do	Do.

MONTANA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	45°-46° ° ′ ″	110°-111° ° ′ ″		
Livingston	25 35 30.60	110 27 33.60	G. S	Bull. 122.
Pass	30 39.80	01 03.40	do	Do.
	45°-46°	111°-112°		
Blackmore, mountain	45 26 48.02	111 00 13.40	do	Do.
Bozeman:				
Astronomical station	40 51.92	02 36.64	do	Do.
North base	42 45.29	06 26.08	do	Do.
South base	39 09.64	04 02.09	do	Do.
Station Y	40 00.52	01 37.08	Wheeler	Do.
Campbell	56 55.82	29 09.18	Mo. R. C	Rept. '91.
Cedar Knoll	39 03.61	13 36.46	G. S	Bull. 122.
Cedar Hill	56 43.20	27 44.22	Mo. R. C	Rept. '91.
Clarke	59 58.75	23 05.51	do	Do.
Gallatin	22 13.27	21 56.86	G. S	Bull. 122.
Do	56 07.65	28 43.28	Mo. R. C	Rept. '91.
Huntley	57 50.20	25 42.38	do	Do.
North base	55 43.36	30 04.84	do	Do.
Point 5	51 24.87	09 12.76	G. S	Bull. 122.
South base	54 58.35	29 43.63	Mo. R. C	Rept. '91.
Spring	57 57.52	28 10.92	do	Do.
	45°-46°	112°-113°		
Jefferson	45 36 49.38	112 00 29.62	G. S	Bull. 122.
Tweedy	28 57.00	57 56.60	do	Do.
	44°-45°	111°-112°		
Hilgard	44 55 08.17	111 27 32.99	do	Do.
Sawtelle	33 56.05	26 40.33	do	Do.

WYOMING.

Name.	Latitude.	Longitude.	Authority.	Reference.
	44°-45° ° ′ ″	107°-108° ° ′ ″		
Cloud Peak	44 23 00.20	107 10 23.00	G. S	Bull. 122.
	44°-45°	109°-110°		
Index Peak	44 58 36.60	109 53 04.00	Hayden	Rept. '77.
Do	58 41.88	52 53.07	G. S	Bull. 122.
	44°-45°	110°-111°		
Sheridan	44 16 06.02	110 31 44.81	do	Do.
Washburne	47 58.95	26 01.85	do	Do
	43°-44°	104°-105°		
Northwest corner of Nebraska	43 00 04.20	104 02 49.60	do	
	43°-44°	106°-107°		
Fort McKinney	43 47 05.60	106 15 12.75	Engr. Corps	Rept. '78.
	43°-44°	108°-109°		
Alamocita Peak	43 11 56.00	108 28 17.00	Wheeler	Rept. '79.
	43°-44°	109°-110°		
Fremont Peak	43 07 28.50	109 37 17.30	Hayden	Rept. '77.
Washakie Needle	44 51.70	12 19.70	do	Do.
Yount Peak	59 02.76	51 58.28	G. S	Bull. 122.
	43°-44°	110°-111°		
Gros Ventre Peak	43 16 54.40	110 14 00.50	Hayden	Rept. '77.
Hayden Mountain	44 29.60	48 22.80	do	Do.
Hoback Peak	05 04.20	34 27.30	do	Do.
	42°-43°	104°-105°		
Fort Laramie flagstaff	42 12 01.31	104 33 27.27	Engr. Corps	Rept. '78.
	42°-43°	105°-106°		
Fort Fetterman	42 50 26.28	105 29 12.60	L. S	Final Rept.
Laramie Peak	16 00.00	26 50.00	Hayden	Rept. '77.
	42°-43°	107°-108°		
Rattlesnake Peak	42 10 01.70	107 03 35.90	do	Do.
Seminole Peak	15 23.50	14 30.00	do	Do.
Whiskey Peak	18 36.70	34 34.50	do	Do.
	42°-43°	108°-109°		
Yellow Butte	42 16 05.30	108 43 18.00	do	Do.
	42°-43°	109°-110°		
Atlantic Peak	42 36 59.30	109 00 16.50	do	Do.
Mount Bonneville	51 35.10	20 48.20	do	Do.
New Fork Peak	59 58.30	35 36.90	do	Do.
West Atlantic Peak	37 17.20	01 07.30	do	Do.
Wind River Peak	42 29.70	09 54.50	do	Do.

WYOMING—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			110°-111°				
	°	′	″	°	′	″		
ning Peak	42	36	14.90	110	37	39.70	Hayden	Rept. '77.
enne:	41°-42°			104°-105°				
stronomical station	41	07	46.62	104	48	51.30	Wheeler	Rept. '73.
ailroad depot		07	57.77		49	11.65	do	Rept. '79.
ll, Fort D. A., flagstaff		08	38.83		50	24.47	do	Do.
	41°-42°			105°-106°				
	41	07	54.55	105	23	44.32	G. S	Bull. 122.
ope		22	10.08		34	23.14	do	Do.
nomical pier		18	51.80		35	33.60	do	Do.
ty road		21	02.92		42	16.45	do	Do.
		10	54.33		27	39.88	do	Do.
Sanders flagstaff		17	26.89		34	59.56	Wheeler	Rept. '73.
		05	52.06		58	28.70	G. S	Bull. 122.
nie		18	51.80		35	33.60	Wheeler	Rept. '72.
ey		06	17.33		38	14.08	G. S	Bull. 122.
zite		25	34.91		27	27.53	do	Do.
Creek station, river bank of k Creek.		50	25.72		52	24.60	Engr. Corps	Rept. '78.
nan		07	50.00		23	33.15	C. & G. S	Rept. '84.
		20	10.28		35	02.97	G. S	Bull. 122.
rsity		18	47.09		34	53.75	do	Do.
	41°-42°			106°-107°				
red Steele flagstaff	41	46	50.63	106	56	54.27	Wheeler	Final Rept.
ine Bow		21	39.40		18	54.20	G. S	Bull. 122.
Steele		50	14.80		59	59.60	Hayden	Rept. '77.
	41°-42°			107°-108°				
kee Peak	41	48	54.60	107	19	42.80	do	Do.
nd of Rawlins base line		25	23.40		18	15.00	do	Do.
as Peak		48	14.90		16	14.90	do	Do.
ation Peak		38	14.40		23	53.50	do	Do.
end of Rawlins base line		46	16.50		21	30.60	do	Do.
	41°-42°			108°-109°				
Butte	41	33	29.40	108	48	12.70	do	Do.
Mountain		58	22.20		58	20.60	do	Do.
	41°-42°			109°-110°				
River, astronomical observ- .	41	31	38.12	109	28	06.57	Wheeler	Final Rept.
utte		38	34.00		21	19.60	Hayden	Rept. '77.
	41°-42°			110°-111°				
ne Butte	41	21	06.50	110	54	42.50	do	Do.

COLORADO.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			102°-103°				
	°	′	″	°	′	″		
rg, astronomical station	40	59	07.63	102	21	32.30	Wheeler	Final Rept.
	40°-41°			105°-106°				
Peak	40	15	20.80	105	36	38.20	Hayden	Rept. '76.
	40°-41°			106°-107°				
iew Peak	40	19	52.20	106	07	53.20	do	Do.
	39°-40°			103°-104°				
	39	02	15.78	103	57	48.43	C. & G. S	Do.
		04	27.83		30	20.07	do	Do.
lson's house, chimney		07	55.27		27	50.48	do	Do.
olhouse chimney		08	08.59		27	50.35	do	Do.
ion-house chimney		07	52.85		27	27.93	do	Do.
d		02	15.04		09	46.75	do	Do.
ary station		05	46.45		32	01.30	do	Do.
	39°-40°			104°-105°				
. Coast Survey astronomical n.	39	45	21.71	104	59	31.94	do	Rept. '82.
:								
end of base		45	52.20		47	39.20	Hayden	Rept. '76.
t end of base		46	22.70		54	25.30	do	Do.
olhouse		45	00.70		59	23.40	do	Do.
station		43	54.80		57	08.90	do	Do.
		04	10.08		30	15.64	C. & G. S	
ek station		56	57.00		55	51.80	Hayden	Do.
Hills		00	02.96		18	30.86	C. & G. S	
, astronomical station		59	24.09		48	58.80	Wheeler	Final Rept.

COLORADO—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			105°-106°				
	°	′	″	°	′	″		
Evans, Mount	39	35	21.80	105	38	21.90	Hayden	Rept. '76.
Georgetown		42	36.36		41	27.64	Wheeler	Final Rept.
Morrison, Mount		40	12.40		12	55.30	Hayden	Rept. '76.
Platte Peak		15	40.50		05	49.00	do	Do.
South Boulder Peak		57	15.60		17	42.10	do	Do.
Torrey Peak		38	37.40		48	01.10	do	Do.
	39°-40°			106°-107°				
Ashcroft	39	02	28.60	106	46	43.40	G. S	Bull. 122.
Bien's Station, 12		08	36.70		52	22.40	do	Do.
Bien's Station, 47		13	17.40		44	10.50	do	Do.
Castle Peak		00	29.80		51	44.00	do	Do.
Highland		07	40.20		52	39.90	do	Do.
Holy Cross Mountain		28	05.20		28	39.10	Hayden	Rept. '76.
La Plata Mountain		01	50.30		28	09.20	do	Do.
Lincoln, Mount		21	09.10		06	26.80	do	Do.
Powell, Mount		45	41.10		20	10.20	do	Do.
	39°-40°			107°-108°				
Chair Mount	39	03	24.00	107	17	00.60	G. S	Bull. 122.
Leon Peak		04	51.00		50	24.70	Hayden	Rept. '76.
North Mam		23	16.60		51	43.80	do	Do.
Snow Mass		07	02.70		04	03.20	G. S	Bull. 122.
Sopris Peak:								
North end		15	52.90		10	21.10	Hayden	Rept. '76.
Middle summit		15	36.20		09	57.40	G. S	Bull. 122.
Treasury		00	46.20		06	00.70	do	Do.
	38°-39°			102°-103°				
Eureka	38	58	34.79	102	51	17.19	C. & G. S	
First View		47	37.47		32	26.54	do	
Section-house chimney		48	57.02		31	58.53	do	
Kit Carson		42	02.30		51	06.24	do	
Landsman		56	47.11		34	46.24	do	
	38°-39°			103°-104°			do	
Adobe	38	40	35.56	103	32	47.47	do	
Arroya		48	04.70		10	26.74	do	
Section-house chimney		51	15.33		07	35.32	do	
Cramer Gulch		35	30.87		55	25.46	do	
Square Bluffs		51	03.06		49	14.73	do	
	38°-39°			104°-105°				
Bear Creek	38	48	51.97	104	52	52.02	do	
Besores ranch, chimney		59	10.76		28	21.04	do	
Big Springs		45	01.22		14	40.77	do	
Colorado City, schoolhouse, southeast chimney.		50	43.76		51	09.31	do	Rept. '82.
Colorado Springs		49	58.02		49	06.14	do	Do.
United States Coast Survey station.		50	00.30		49	07.60	do	Do.
Public school flagstaff		50	06.21		48	58.63	do	Do.
Corps of Engineers, astronomical station.		49	38.69		49	16.47	do	Do.
College cupola		50	47.92		49	01.66	do	Do.
Corral Bluffs		52	06.45		35	05.34	do	Do.
El Paso:								
West base (1879)		58	37.96		34	50.31	do	
East base (1879), astronomical station.		57	17.10		27	12.98	do	
Glen Eyre		53	54.14		53	58.95	do	
Munson and Hamblin's barn		57	28.92		27	09.04	do	
Pemington, house chimney		58	42.62		41	57.72	do	
South Pueblo		15	42.84		36	57.53	Wheeler	
	38°-39°			105°-106°				
Clayton Cone	38	12	58.20	105	55	29.30	Hayden	Rept. '76.
Hunt Peak		23	03.30		50	30.50	do	Do.
Labran, astronomical monument		23	08.97		06	17.78	Wheeler	Do.
Pikes Peak		50	21.11		02	03.30	C. & G. S	
Rito Alto Peak		13	14.20		45	10.10	Hayden	Do.
San Luis base:								
South end		15	14.00		57	07.00	do	Do.
North end		19	40.30		59	04.40	do	Do.
	38°-39°			106°-107°				
Agency Peak	38	16	30.70	106	51	47.60	do	Do.
Gunnison, northeast corner Virginia avenue and Wisconsin street.		32	42.13		55	39.49	do	Do.
Harvard Mount		55	32.20		19	01.30	do	Do.
Hunt Peak		25	23.40		13	10.40	Wheeler	Final Rept.
Observatory Cone		34	40.60		51	36.70	do	Do.
Ouray Mount		25	26.10		13	15.70	Hayden	Rept. '76.
Princeton Mount		45	01.30		14	19.20	do	Do.
Station 23		16	34.60		06	00.60	do	Do.

COLORADO—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			106°-107°				
	°	′	″	°	′	″		
Station 24	38	19	34.20	106	12	52.90	Hayden	Rept. '73.
Station 33		01	27.80		55	11.40	do	Do.
	38°-39°			107°-108°				
Blaine Peak	38	00	14.00	107	47	22.00	Wheeler	Final Rept.
Carbon Mountain		47	38.60		02	23.90	do	Do.
Handie Peak		54	46.20		30	05.50	do	Do.
Horsefly Mount		11	42.50		55	38.60	do	Do.
Mears Peak		01	50.10		54	23.40	do	Do.
Sneffels Mount		00	19.00		47	18.70	Hayden	Rept. '76.
Uncompahgre Peak		04	23.00		27	30.10	do	Do.
West Elk Peak		43	09.20		11	44.20	do	Do.
Wetterhorn		03	45.60		30	30.90	Wheeler	Final Rept.
	38°-39°			108°-109°				
Grand Mesa	38	53	34.00	108	10	26.00	do	Do.
	37°-38°			104°-105°				
Fisher Peak	37	05	59.60	104	27	31.90	Hayden	Rept. '76.
East Spanish Peak		23	40.50		54	59.90	do	Do.
West Spanish Peak		22	37.60		59	24.30	do	Do.
Trinidad, United States Coast Survey station.		10	13.80		30	07.50	do	Do.
	37°-38°			105°-106°				
Blanca Peak	37	34	43.50	105	28	55.40	do	Do.
Culebra Peak		07	25.10		10	56.30	do	Do.
Crestone Peak		58	05.30		34	54.00	do	Do.
Garland, Fort, flagstaff		25	27.33		25	33.73	Wheeler	Rept. '79.
	37°-38°			106°-107°				
Banded Peak	37	06	21.00	106	37	24.50	Hayden	Rept. '76.
Conejos Peak		17	24.50		34	02.40	do	Do.
Del Norte Peak		28	58.00		25	53.00	Wheeler	Final Rept.
Del Norte Hill		40	13.80		21	25.50	do	Do.
Macomb Peak		34	25.40		58	43.00	do	Do.
Meigs Peak		21	01.50		41	38.80	do	Do.
San Luis Peak		59	16.80		55	39.20	Hayden	Rept. '76.
Station 28		35	18.10		32	16.40	do	Do.
Station 81		02	30.60		37	31.60	do	Do.
South River Peak		34	31.70		58	40.20	do	Do.
Summit Peak		21	07.30		41	35.40	do	Do.
	37°-38°			107°-108°				
Æolus Mount	37	37	39.40	107	36	15.40	Wheeler	Final Rept.
Bristol Head		47	34.50		03	17.90	do	Do.
Buffalo Peak		36	24.40		29	26.80	do	Do.
Canby Mount		46	54.60		30	50.00	do	Do.
Engineer Mountain		41	57.10		48	14.10	do	Do.
Glacier Mount		50	20.70		59	20.00	do	Do.
Pagosa Peak		26	43.10		03	47.20	Hayden	Rept. '76.
Pole Creek Mountain		47	30.50		25	25.70	Wheeler	Final Rept.
Red Cloud Peak		56	26.70		25	07.80	do	Do.
Rio Grande Pyramid		40	52.20		23	19.20	Hayden	Rept. '76.
Simpson Mount		40	53.70		23	11.30	Wheeler	Final Rept.
Sultan Mountain		47	09.60		42	03.60	do	Do.
Wilson Mount		50	26.40		59	16.90	Hayden	Rept. '76.
	37°-38°			108°-109°				
Dunn Peak	37	50	24.20	108	05	37.20	Wheeler	Final Rept.
Hesperis Peak		26	44.20		05	02.20	Hayden	Rept. '76.
Lone Cone		53	19.20		15	04.40	do	Do.
Ute Peak		17	03.00		46	42.50	G. S	Bull. 122.

NEW MEXICO.

	36°-37°			103°-104°				
	°	′	″	°	′	″		
Carriso	36	09	12.70	103	58	35.90	G. S	Bull. 122.
	36°-37°			104°-105°				
Cimarron, astronomical monument	36	30	10.01	104	54	59.04	Engr. Corps	Rept. '76.
Laughlin		37	33.20		11	08.00	G. S	Bull. 122.
	36°-37°			105°-106°				
Costilla Peak	36	50	06.00	105	13	09.40	Hayden	Rept. '76.
Ocate		05	42.90		03	38.30	G. S	Bull. 122.
Taos Peak		33	23.00		24	46.00	Wheeler	Final Rept.
	36°-37°			106°-107°				
Copper	36	01	59.90	106	51	16.80	G. S	Bull. 122.
Langley		00	28.00		23	03.30	do	Do.
Plaza La Nutria		42	04.63		23	40.99	Engr. Corps	Rept. '76.
Santa Clara Mountain		00	25.80		22	54.00	Wheeler	Final Rept.

NEW MEXICO—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	36°-37°			107°-108°				
	°	′	″	°	′	″		
La Huerfano	36	25	34.10	107	50	41.20	G. S	Bull. 122
	36°-37°			108°-109°				
San Juan Needle	36	41	15.20	108	49	50.40	Hayden	Rept. '76.
	35°-36°			104°-105°				
Aguilar	35	22	43.10	104	59	37.60	G. S	Bull. 122.
Canadian		59	03.60		35	15.10	do	Do.
Corazon		27	09.80		33	57.40	do	Do.
Montoya		43	21.00		09	43.30	do	Do.
	35°-36°			105°-106°				
Baldy	35	49	57.50	105	45	27.90	do	Do.
Bernal Hill		22	33.00		19	38.40	Wheeler	Final Rept.
Escobas Peak		32	02.00		42	45.00	do	Do.
Fort Union		54	24.86		00	51.15	Engr. Corps	Rept. '73.
Jacinto		05	26.00		26	59.40	G. S	Bull. 122.
Las Truchas Mountain		57	40.70		38	39.10	Wheeler	Final Rept.
Las Vegas		35	27.66		13	27.57	do	Do.
Rincon		46	03.10		33	11.40	G. S	Bull. 122.
Santa Fe		41	19.29		56	45.22	Wheeler	Final Rept.
Thompson		40	22,10		48	22.90	G. S	Bull. 122.
Albuquerque:	35°-36°			106°-107°				
Armijo House, flagstaff	35	05	02.25	106	39	11.64	do	Bull. 49.
Grant Block, flagstaff		05	03.12		39	11.09	do	Do.
San Felipe Hotel, flagstaff, Gold avenue.		04	59.78		39	21.02	do	Do.
Astronomic pier		04	32.40		39	12.47	do	Do.
Catholic church cross		05	09.70		39	23.04	do	Do.
Jemes		41	44.70		51	30.60	do	Do.
Placer Mountain		20	03.40		10	36.00	Wheeler	Final Rept.
Sandia		14	07.30		27	22.00	G. S	Bull. 122.
Tetilla Peak		36	24.30		13	00.80	Wheeler	Final Rept.
SW. corner sec. 17, T. 10 N., R. 3 E		05	13.26		39	35.66	G. S	Bull. 122.
	35°-36°			107°-108°				
Taylor	35	14	20.70	107	36	29.20	do	Do.
	35°-36°			108°-109°				
Astronomical pier	35	30	51.38	108	32	27.32	do	Do.
Chusca		53	06.70		50	14.50	do	Do.
East base		30	17.80		30	28.06	do	Do.
Fort Wingate, flagstaff		28	49.47		32	20.00	Wheeler	Final Rept.
Hosta		35	13.50		11	29.90	G. S	Bull. 122.
McKenzie		21	18.70		26	35.10	do	Do.
Nell		25	13.50		37	24.90	do	Do.
Pyramid		33	18.80		37	01.10	do	Do.
Square Mesa		13	07.70		16	46.90	do	Do.
Twins		29	39.80		50	04.50	do	Do.
West base		31	48.38		34	30.74	do	Do.
Zuni		07	25.90		54	40.30	do	Do.
	34°-35°			104°-105°				
Jospinto No. 1	34	56	42.00	104	57	10.00	do	Do.
Jospinto No. 2		56	36.80		56	57.20	do	Do.
	34°-35°			105°-106°				
Pedernal	34	50	44.00	105	38	38.30	do	Do.
Pedernal Peak		50	38.50		39	04.20	Wheeler	Final Rept.
Rattlesnake Hill		34	07.50		49	41.40	do	Do.
Tecolote Peak		04	37.00		41	44.00	do	Do.
	34°-35°			106°-107°				
Manzano Peak	34	35	23.20	106	27	12.20	do	Do.
Mosca Peak		48	36.50		24	34.50	do	Do.
Osha Peak		38	09.30		26	43.60	do	Do.
	34°-35°			107°-108°				
Ladrones	34	26	01.00	107	05	29.50	do	Do.
	34°-35°			108°-109°				
Pinon	34	11	51.10	108	27	52.10	G. S	Bull. 122.
	33°-34°			105°-106°				
Blanca Peak	33	22	24.00	105	48	55.00	Wheeler	Final Rept.
Capitan Peak		35	24.40		16	20.30	do	Do.
East Carrizo Cone		38	59.60		37	17.50	do	Do.
Fort Stanton, flagstaff		29	35.72		31	59.72	do	Do.
Nogal Peak		29	47.50		48	36.20	do	Do.
	33°-34°			106°-107°				
Colorado Mountain	33	50	42.00	106	42	06.00	do	Do.
Salinas Peak		17	50.60		32	15.00	do	Do.
	33°-34°			107°-108°				
Caballo Cone	33	06	01.80	107	13	40.40	do	Do.
Fort Craig, flagstaff		38	00.99		01	07.96	do	Do.

NEW MEXICO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	33°-34°	107°-108°		
	° ′ ″	° ′ ″		
Fra Cristobal Mount	33 25 35.00	107 07 10.10	Wheeler	Final Rept.
Mount Magdalena	59 23.20	11 39.10	do	Do.
San Mateo Mountain	33 07.30	26 04.90	do	Do.
	33°-34°	108°-109°		
Eagle Peak	33 40 33.20	108 34 41.30	do	Do.
Horse Peak	58 38.20	07 29.90	do	Do.
Round Peak	40 28.70	06 06.70	do	Do.
Tuleroso	40 37.70	34 34.90	G. S	Bull. 122.
	32°-33°	105°-106°		
Cornuda	32 01 28.44	105 30 57.65	do	Do.
	32°-33°	106°-107°		
Organ Mountain	32 20 34.40	106 33 40.50	Wheeler	Final Rept.
	32°-33°	107°-108°		
Florida Peak	32 07 18.30	107 37 19.20	do	Do.
Mount Cooke	32 01.40	43 53.90	do	Do.
Sunday Cone	37 08.50	26 54.00	do	Do.
	32°-33°	108°-109°		
Bear Peak	32 50 00.70	108 21 31.60	do	Do.
Black Peak	54 26.00	09 46.90	do	Do.
Fort Bayard, astronomical monument	47 40.35	09 08.77	do	Do.
	31°-32°	106°-107°		
Rodadero Peak	31 47 10.30	106 32 31.70	do	Do.
	31°-32°	107°-108°		
Potrillo Peak	31 55 21.00	107 04 07.00	do	Do.
	31°-32°	108°-109°		
Hacheta Peak	31 37 58.20	108 23 57.00	do	Do.
Lalacha Peak	50 21.20	27 13.60	do	Do.

ARIZONA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	36°-37°	109°-110°		
	° ′ ″	° ′ ″		
Calabasa	36 22 18.30	109 50 16.70	G. S	Bull. 122.
Pastora	47 25.10	09 52.80	do	Do.
Roof Butte	27 37.10	05 31.40	do	Do.
Sonsala	06 05.20	04 41.70	do	Do.
	36°-37°	110°-111°		
Wilson	36 12 48.30	110 09 13.60	do	Do.
	36°-37°	111°-112°		
Paria Needle	36 51 00.60	111 40 54.60	Powell	Do.
Paria Station	50 49.20	40 47.70	do	Do.
	36°-37°	112°-113°		
Brink	36 26 01.60	112 25 11.60	do	Do.
Brow	35 25.00	23 56.70	do	Do.
Duffer	56 50.10	00 50.20	do	Do.
Kanab:				
North	57 46.50	31 21.40	do	Do.
South	54 04.10	31 50.90	do	Do.
New	55 29.80	35 36.40	do	Do.
Pipe	52 37.30	48 37.40	do	Do.
Pipe Springs, camp near	51 36.34	42 57.00	Wheeler	Rept. '76.
Shinarump	57 53.90	26 45.00	Powell	Bull. 122.
Three Trees	59 27.60	41 51.30	do	Do.
	36°-37°	113°-114°		
Emma	36 15 50.20	113 10 12.40	G. S	Do.
	35°-36°	109°-110°		
Crofton	35 11 39.30	109 06 51.80	do	Do.
Douglas	09 08.60	52 35.10	do	Do.
Iola	26 18.40	38 10.60	do	Do.
Zilh Tusayan	53 11.70	14 55.10	do	Do.
	35°-36°	110°-111°		
Cottonwood	35 30 26.70	110 18 59.60	do	Do.
Oraibe	52 50.40	42 49.20	do	Do.
	35°-36°	111°-112°		
San Francisco	35 20 47.00	111 40 37.80	do	Do.
	35°-36°	112°-113°		
Bill Williams	35 11 59.60	112 12 15.40	do	Do.
Floyd	23 33.60	43 24.10	do	Do.
	35°-36°	113°-114°		
Hualapai	35 04 30.20	113 53 48.30	do	Do.

ARIZONA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	35°-36°			114°-115°				
	°	′	″	°	′	″		
Dead	35	16	30.30	114	43	20.30	G. S	Bull. 122.
Fort Mohave		02	09.00		35	54.00	Wheeler	Final Rept.
Tipton		32	21.10		11	30.10	G. S	Bull. 122.
	34°-35°			109°-110°				
Haseltine	34	59	24.30	109	26	43.10	do	Do.
	34°-35°			110°-111°				
Chevlon	34	41	33.80	110	50	52.10	do	Do.
Sunset		54	14.70		57	39.80	do	Do.
Woodruff		47	56.70		02	31.10	do	Do.
	34°-35°			111°-112°				
Baker Butte	34	27	08.60	111	22	39.60	do	Do.
Mazatzal		03	45.70		27	38.50	do	Do.
	34°-35°			112°-113°				
Granite	34	38	17.00	112	33	08.30	do	Do.
Fort Whipple		33	06.12		27	10.20	Wheeler	Final Rept.
	34°-35°			113°-114°				
Aquarius	34	56	56.20	113	17	51.00	G. S	Bull. 122.
	33°-34°			109°-110°				
Ord Peak	33	56	16.00	109	36	15.80	do	Do.
Thomas Peak		54	24.10		34	16.00	Wheeler	Final Rept.
	33°-34°			111°-112°				
Brown Peak	33	41	04.20	111	19	29.60	G. S	Bull. 122.
	32°-33°			109°-110°				
Graham	32	41	58.90	109	52	18.90	Wheeler	Final Rept.

UTAH.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			111°-112°				
	°	′	″	°	′	″		
Barton Mountain	41	04	51.80	111	51	19.90	Wheeler	Final Rept.
Kimballs Mountain		57	40.00		13	57.00	do	Do.
Lake View Peak		57	35.90		14	07.30	Hayden	Rept. '77.
Naomi Peak		54	38.90		40	46.30	Wheeler	Final Rept.
North Lyon Peak		54	39.00		40	46.50	Hayden	Rept. '77.
North Ogden Mountain		21	44.80		57	53.00	Wheeler	Final Rept.
Observatory Peak		11	56.80		53	09.60	do	Do.
Ogden, stone post in observatory		13	08.56		59	56.10	L. S	
Ogden Peak		11	56.70		53	09.50	Hayden	Rept. '77.
Porcupine Mountain		01	07.00		07	06.80	Wheeler	Final Rept.
Willard Peak		21	44.90		57	53.10	Hayden	Rept. '77.
	41°-42°			112°-113°				
Black Butte	41	55	36.00	112	07	37.00	Wheeler	Final Rept.
Blue Spring Peak		47	36.00		32	54.40	do	Do.
Box Elder Peak		38	05.90		01	07.30	do	Do.
Promontory Mountain		29	21.80		30	44.90	do	Do.
South Promontory Mountain		18	45.80		27	04.90	do	Do.
	41°-42°			113°-114°				
Clear Creek Mountain	41	41	22.50	113	44	44.00	do	Do.
Newfoundland Mountain		11	06.70		22	19.20	do	Do.
Tangent Peak		28	50.60		10	42.20	do	Do.
Camp Douglas:	40°-41°			111°-112°				
New flagstaff	40	45	47.50	111	50	14.22	do	Do.
Old flagstaff		45	47.58		50	14.07	do	Rept. '76.
Sundial		45	47.47		50	13.92	Engr. Corps	Do.
Provo (old Camp Rawlins)		13	47.84		40	27.00	Wheeler	Repts. '72-'73.
Salt Lake City		46	04.00		53	47.10	C. & G. S.	Rept. '84.
Spanish Fork		05	13.50		31	40.70	Powell	Bull. 122.
West Twin Peak		35	44.40		43	41.80	Wheeler	Final Rept.
	40°-41°			112°-113°				
Antelope Island	40	57	40.40	112	13	12.10	do	Do.
Provo		13	47.84		40	27.00	do	Rept. '76.
	40°-41°			113°-114°				
Deep Creek	40	06	01.71	113	57	16.05	do	Do.
Desert Mountain		57	02.40		47	36.20	do	Final Rept.
	39°-40°			109°-110°				
Culmination	39	11	27.10	109	46	47.50	Powell	Bull. 122.
	39°-40°			110°-111°				
Bruin	39	38	37.10	110	20	56.40	do	Do.
Indian Head		51	44.20		53	26.40	do	Do.
Red Plateau		10	14.00		37	10.90	do	Do.

UTAH—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	39°-40°	111°-112°		
	° ′ ″	° ′ ″		
Bare Brush	39 04 08.70	111 18 39.10	Powell	Bull. 122.
Ephraim	23 25.60	45 06.60	do	Do.
Fayette	12 31.50	49 20.30	do	Do.
Gunnison:				
Astronomical station	09 25.62	49 15.00	Wheeler	Final Rept.
North	08 28.30	49 16.20	Powell	Bull. 122.
South	03 10.20	49 16.20	do	Do.
Jura	04 49.70	46 00.60	do	Do.
Musinia	02 08.30	34 40.60	do	Do.
Nebo	48 35.40	45 59.70	do	Do.
South Tent	23 29.10	21 28.20	do	Do.
Valley	05 38.30	56 20.00	do	Do.
	39°-40°	112°-113°		
Canyon Range	39 23 30.70	112 12 28.50	do	Do.
	38°-39°	109°-110°		
Peale	38 26 18.10	109 13 44.30	G. S	Do.
Waas	32 21.20	13 39.70	do	Do.
Do	32 18.60	13 41.80	Powell	Do.
	38°-39°	110°-111°		
Ellen	38 07 14.30	110 48 53.60	do	Do.
	38°-39°	111°-112°		
Black Cap	38 57 16.30	111 49 15.70	do	Do.
Fort Cameron	16 53.34	44 00.31	Wheeler	Final Rept.
Hilgard	41 00.40	32 38.20	Powell	Bull. 122.
Marvine	40 02.90	38 28.30	do	Do.
Thousand Lake	24 58.50	28 45.30	do	Do.
	38°-39°	112°-113°		
Beaver, astronomical monument near center of public square.	38 16 23.28	112 38 35.90	Wheeler	Final Rept.
Belknap	25 06.60	24 45.50	Powell	Bull. 122.
Katherine	59 35.00	08 24.70	do	Do.
Richfield	46 11.40	02 27.00	Wheeler	Final Rept
	37°-38°	109°-110°		
Abajo	37 50 22.50	109 27 43.70	G. S	Bull. 122.
	37°-38°	110°-111°		
Navajo Mountain	37 02 02.90	110 52 08.70	do	Do.
Pennell	57 21.40	47 27.90	Powell	Do.
	37°-38°	111°-112°		
Table Cliff	37 41 08.70	111 54 08.60	do	Do.
	37°-38°	112°-113°		
Adams	37 55 53.80	112 12 20.90	do	Do.
Brian	40 49.30	49 53.10	do	Do.
John	02 52.50	30 56.70	do	Do.
Kanab, monument in square in front of Bishop's residence.	02 25.43	31 39.00	Wheeler	Rept. '76.
Little Creek	52 48.40	36 43.40	Powell	Bull. 122.
Mansard	02 52.30	25 22.00	do	Do.
Mollie	16 12.30	03 18.60	do	Do.
Navajo Well	03 36.70	16 45.00	do	Do.
Pink Cliff	25 02.70	19 21.10	do	Do.
Street	02 55.85	31 50.83	do	Do.
Tithing Yard	02 55.90	31 50.00	do	Do.
	37°-38°	113°-114°		
St. George	37 06 29.38	113 35 00.30	Wheeler	Final Rept.
Toquerville	15 19.88	16 20.90	do	Rept. '76.

NEVADA.

	41°-42°	114°-115°		
	° ′ ″	° ′ ″		
Pilot Knob	41 01 12.20	114 04 51.50	Wheeler	Final Rept.
	41°-42°	119°-120°		
Division Peak	41 05 46.10	119 15 31.50	do	Do.
Mahogany Mount	01 26.40	33 17.90	do	Do.
Forty-nine Peak	33 24.00	55 23.00	do	Do.
Piute Peak	16 43.00	03 23.00	do	Do.
Yellow Mesa Peak	50 05.00	37 15.80	do	Do.
	40°-41°	115°-116°		
Fort Halleck	40 48 34.35	115 19 34.05	do	Do.
Camp Ruby	03 38.63	31 06.75	do	Do.
Elko	49 38.44	45 37.20	do	Do.

NEVADA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	40°-41°	116°-117°		
	° ′ ″	° ′ ″		
Battle Mountain, astronomical monument.	40 38 18.74	116 56 13.50	Wheeler	Final Rept.
	40°-41°	117°-118°		
Granite Peak, south end	40 22 30.10	117 31 35.80	C. & G. S	
Winnemucca, astronomical monument.	58 19.97	43 54.16	Wheeler	Do.
	40°-41°	118°-119°		
Star Peak (Indian Peak)	40 31 15.47	118 10 16.61	C. & G. S	
	40°-41°	119°-120°		
Granite Peak	40 47 22.60	119 25 47.70	Wheeler	Do.
Tohakum Peak	10 40.20	27 07.60	do	Do.
State Line Peak	01 44.00	58 32.40	do	Do.
Do	01 42.10	58 45.40	G. S	Bull. 122.
	39°-40°	115°-116°		
Hamilton	39 15 48.87	115 25 58.38	do	
Monte Cristo Mill	13 16.83	34 49.20	do	
	39°-40°	117°-118°		
Augusta Peak	39 32 18.58	117 55 11.91	C. & G. S	
Austin, astronomical station	29 21.92	08 41.70	Wheeler	
Birchims Mount	08 53.60	28 33.50	do	Rept. '79.
Bunker Hill	15 05.02	07 35.83	C. & G. S	
Cowles Peak	03 14.40	33 24.90	Wheeler	Do.
Desatoya:				
North Twin	22 04.20	45 36.80	C. & G. S	
South Twin	21 49.41	45 34.53	do	
Emigrant Peak	24 10.20	23 20.10	Wheeler	Do.
Geneva Peak	21 27.00	04 14.90	do	Do.
Mount Grant	32 16.60	54 56.20	do	Do.
North Augusta	41 01.90	48 26.70	C. & G. S	
Shoshone Peak:				
North	08 56.20	28 49.80	do	Do.
South	03 17.60	33 41.10	do	Do.
Toyabe Peak	21 28.71	04 32.74	do	Do.
	39°-40°	118°-119°		
Carson Sink	39 34 53.62	118 14 09.27	do	Do.
Carson Table	32 23.40	17 58.50	do	Do.
Fairview	13 24.86	09 10.77	do	Do.
Mount Lincoln	32 52.50	15 48.70	do	Do.
Tarogua Peak	34 51.70	13 54.20	Wheeler	Do.
	39°-40°	119°-120°		
Churchill Butte	39 20 16.80	119 17 32.20	do	Do.
Cleaver Peak	13 01.10	08 01.90	G. S	Bull. 122.
Como	01 11.40	28 27.59	C. & G. S	
Do	01 07.50	28 14.40	Wheeler	Final Rept.
Emma	17 59.30	36 00.90	do	Do.
Genoa	02 26.40	52 43.00	do	Do.
Genoa Peak	02 29.50	52 54.40	G. S	Bull. 122.
McClellan Mountain	15 26.10	41 46.20	Wheeler	Final Rept.
Mount Davidson	18 21.90	39 37.20	do	Do.
Do	18 24.09	39 49.78	C. & G. S	
Mount Lyon	07 33.20	23 12.40	Wheeler	Do.
Mount Rose	20 32.30	55 05.90	G. S	Bull. 122.
Mucca, Elephant Peak	58 28.40	44 40.10	C. & G. S	
Northeast base	25 43.00	25 39.00	Wheeler	Final Rept.
Pahrah	47 34.73	28 28.74	C. & G. S	
Peavine Mountain	35 07.40	55 57.00	G. S	Bull. 122.
Pond Summit	39 02.38	27 50.78	C. & G. S	
Rawe Mountain	11 56.51	28 40.40	Wheeler	Final Rept.
Rocky Point	20 50.20	34 02.40	do	Do.
Rose Mountain	20 30.30	54 54.10	do	Do.
Sage	07 35.66	28 24.97	C. & G. S	
Tibbie	22 08.60	31 54.60	Wheeler	Rept. '79.
Do	22 10.70	32 07.30	G. S	Bull. 122.
Twotips Mount	42 52.80	09 46.60	Wheeler	Final Rept.
Two Tips, north summit	42 54.70	09 59.90	C. & G. S	
Virginia City, astronomical monument.	17 35.92	39 06.35	do	
Virginia Peak	45 14.95	27 41.60	do	
Washoe Peak, monument	20 32.24	55 05.68	do	
	38°-39°	117°-118°		
Lone Mountain	38 01 22.26	117 29 41.77	do	Do.
Paradise Peak	48 15.90	49 22.70	Wheeler	Do.
Poston Mount	49 48.40	20 56.00	do	Do.
Toyabe Dome	49 52.29	21 12.85	C. & G. S	
	38°-39°	118°-119°		
Basalt Peak	38 59 09.80	118 25 59.00	Wheeler	Do.
Black Mount	56 19.40	54 39.60	G. S	Bull. 122.

NEVADA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	38°-39°	118°-°119		
	° ′ ″	° ′ ″		
Mount	38 33 57.40	118 47 15.90	Wheeler	Final Rept.
t Grant	34 07.83	47 30.60	C. & G. S	
t Hull (Cory's Peak)	26 47.70	46 58.10	do	
Cone	59 12.86	26 14.06	do	
no	23 37.50	09 35.20	do	
ck, south peak	46 57.92	50 05.57	do	
	38°-39°	119°-120°		
t Creek Peak	38 36 45.20	119 18 58.00	G. S	Bull. 122.
t Wilson	50 57.90	13 14.50	do	Do.
Galena	53 17.41	30 09.33	C. & G. S	
Lake Mountain	51 45.00	28 34.00	Wheeler	Final Rept.
	37°-38°	114°-115°		
observatory	37 55 26.07	114 26 18.27	do	Do.
	37°-38°	117°-118°		
zuma Peak	37 41 35.50	117 21 45.70	C. & G. S	
	36°-37°	115°-116°		
ston	36 16 18.00	115 41 38.70	G. S	Bull. 122.

IDAHO.

Name.	Latitude.	Longitude.	Authority.	Reference.
	44°-45°	115°-116°		
	° ′ ″	° ′ ″		
John	44 10 52.00	115 47 24.25	G. S	Bull. 122.
	44°-45°	116°-117°		
llow	44 12 20.60	116 27 02.71	do	Do.
	00 09.66	24 45.96	do	Do.
Weiser	42 37.77	16 14.15	do	Do.
	15 56.20	54 05.40	do	Do.
	43°-44°	111°-112°		
Mount	43 21 46.70	111 05 54.80	Hayden	Rept. '77.
a Mountain	05 36.20	18 56.70	do	Do.
	43°-44°	113°-114°		
tte	43 23 42.20	113 01 38.00	Wheeler	Final Rept.
	43°-44°	114°-115°		
Spring	43 12 48.03	114 54 49.34	G. S	Bull. 122.
Mount	29 30.71	28 04.61	do	Do.
Dome	29 33.93	56 14.94	do	Do.
Side	56 16.25	58 21.50	do	Do.
	43°-44°	115°-116°		
	43 14 54.66	115 26 08.64	do	Do.
	13 07.26	59 40.65	do	Do.
	25 57.75	29 21.53	do	Do.
	35 54.90	25 48.56	do	Do.
Point	30 21.70	56 07.48	do	Do.
	43°-44°	116°-117°		
stronomical pier	43 35 57.98	116 13 04.04	do	Do.
ll	42 16.52	41 46.82	do	Do.
se	32 43.47	10 19.64	do	Do.
p	15 44.31	53 11.56	do	Do.
Point	22 18.20	23 42.80	do	Do.
Peak	36 17.84	03 45.61	do	Do.
Butte	29 18.21	42 49.56	do	Do.
	46 16.45	05 25.26	do	Do.
Ridge, 1	30 50.88	13 43.64	do	Do.
Ridge, 2	28 28.67	06 47.39	do	Do.
	46 23.49	25 00.00	do	Do.
ock	35 35.69	08 45.34	do	Do.
ase	35 14.19	14 49.70	do	Do.
alley base:	42°-43°	111°-112°		
t end	42 27 18.90	111 19 48.00	Hayden	Rept. '77.
t end	27 22.70	22 04.00	do	Do.
Rock	12 09.00	33 08.00	Wheeler	Final Rept.
ll	28 49.70	19 19.60	Hayden	Rept. '77.
Hill	31 15.60	24 54.50	do	Do.
ak	12 08.80	33 11.80	do	Do.
Mount	29 42.60	15 11.00	do	Do.
k Peak	30 54.00	55 39.90	Wheeler	Final Rept.
ak	27 53.70	33 11.40	Hayden	Rept. '77.
Hill	23 41.10	23 34.40	do	Do.

IDAHO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	112°-113°		
	° ′ ″	° ′ ″		
Bannock Peak	42 36 08.80	112 42 43.00	Wheeler	Final Rept.
Deep Creek Mountain	28 13.10	39 37.70	do	Do.
Elkhorn Mountain, north point	20 00.30	19 56.60	do	Do.
Oxford Peak	16 07.60	06 05.40	do	Do.
Putnam, Mount	57 10.60	10 09.40	Hayden	Rept. '77.
South Putnam Peak	55 03.40	07 58.60	Wheeler	Final Rept.
	42°-43°	113°-114°		
Badger Peak	42 33 00.90	113 04 01.00	do	Do.
Black Pine Mountains	07 08.50	07 27.90	do	Do.
Cache Peak	11 04.10	39 54.80	do	Do.
Cedar Creek Mountain	26 46.10	03 34.60	do	Do.
Pillar Butte	52 57.70	13 08.70	do	Do.
	42°-43°	116°-117°		
Quicksilver	42 58 48.47	116 30 32.46	G. S	Bull. 122.

WASHINGTON.

Name.	Latitude.	Longitude.	Authority.	Reference.
	47°-48°	117°-118°		
	° ′ ″	° ′ ″		
Spokane Falls, monument one-fourth mile east of the town.	47 39 38.13	117 24 45.89	Engr. Corps	Rept. '82.
	47°-48°	122°-123°		
Seattle	47 35 57.20	122 19 58.70	C. & G. S	
Steilacoom:				
Presbyterian church	10 24.08	35 35.76	do	
Methodist church	10 23.03	35 50.88	do	
	46°-47°	117°-118°		
Colfax, monument on an island in Palouse River, at north end of the town.	46 53 13.69	117 23 29.13	Engr. Corps	Do.
	46°-47°	118°-119°		
Wallawalla	46 03 55.89	118 20 50.14	Wheeler	Final Rept.
	46°-47°	122°-123°		
Kalama	46 00 17.80	122 50 33.20	C. & G. S	
	46°-47°	123°-124°		
Alamicut River	46 18 03.13	123 41 59.19	do	
Astoria Point	11 23.65	50 29.35	do	
Bakers Bay	16 27.50	55 49.17	do	
Base on east end	18 12.74			

OREGON.

Name.	Latitude.	Longitude.	Authority.	Reference.
	45°-46°	121°-122°		
	° ′ ″	° ′ ″		
Dalles	45 35 50.80	121 13 11.20	Wheeler	Final Rept.
	42°-43°	120°-121°		
Baldy	42 07 03.70	120 43 06.90	G. S	Bull. 122.
High Rock	29 42.70	52 40.40	do	Do.
Lolochewis Mountain	18 22.00	37 38.00	Wheeler	Final Rept.
North End Mountain	03 54.00	14 13.00	do	Do.
Sugarloaf Mountain	17 57.60	07 12.40	do	Do.
	42°-43°	122°-123°		
Pitt	42 28 36.40	122 18 58.40	G. S	Bull. 122.
Scott	55 18.90	01 00.20	do	Do.
	42°-43°	123°-124°		
Kirby	42 13 08.20	123 27 42.60	do	Do.

CALIFORNIA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	120°-121°		
	° ′ ″	° ′ ″		
Alturas Hill	41 28 57.70	120 32 43.00	Wheeler	Final Rept.
Bidwell Mount	56 52.60	07 49.80	do	Do.
Bidwell Fort, flagstaff	51 30.84	09 15.56	do	Do.
Cedar Mount	36 31.90	16 00.20	do	Do.
Eagle Mountain	16 56.00	11 51.40	do	Do.
Hat Mountain	03 57.00	05 47.90	do	Do.

CALIFORNIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			122°-123°				
	°	′	″	°	′	″		
Shasta	41	24	27.60	122	11	42.90	G. S	Bull. 122.
	40°-41°			120°-121°				
Fredonyer Peak	40	41	11.00	120	35	44.40	Wheeler	Final Rept.
Hot Springs Peak		22	24.80		07	07.30	do	Do.
Kettle Rock Peak		08	42.00		43	03.10	do	Do.
McKesick Peak		05	22.90		14	43.10	do	Do.
McDonald Peak		56	23.20		24	35.70	do	Do.
Observation Peak		46	22.20		10	06.90	do	Do.
Schaffer Mount		26	43.10		21	18.60	do	Do.
South Fork Mountain		09	14.30		33	39.50	do	Do.
Thompson Peak		15	34.10		33	17.40	do	Do.
Warren Peak		22	38.70		12	59.60	do	Do.
	40°-41°			121°-122°				
Butt Mountain	40	12	58.20	121	23	02.10	do	Do.
Dyer Mount		14	15.20		01	48.40	do	Do.
Hoffman Butte		36	35.70		33	13.50	G. S	Bull. 122.
Lassen Butte		29	11.21		30	16.21	C. & G. S	Do.
	40°-41°			122°-123°				
Linn	40	02	05.70	122	51	16.50	G. S	Do.
	40°-41°			123°-124°				
Thompson	40	58	15.20	123	00	09.90	do	Do.
	40°-41°			124°-125°				
Eureka, Methodist church	40	48	11.00	124	09	41.00	C. & G. S	
	39°-40°			120°-121°				
Adams Mountain	39	54	32.20	120	05	43.20	Wheeler	Final Rept.
Banner Hill		14	39.40		57	56.60	G. S	Bull. 122.
Castle Peak		21	48.60		20	47.30	Wheeler	Final Rept.
Crystal Peak		28	20.90		02	13.50	do	Do.
Downieville		35	29.80		38	39.30	do	Do.
Duncan Peak		08	32.10		30	33.90	G. S	Bull. 122.
Fillmore		43	43.50		51	10.30	do	Do.
Haskell Peak		39	40.70		33	01.00	Wheeler	Final Rept.
Ingalls		59	33.70		37	40.10	G. S	Bull. 122.
Lola		25	53.34		21	55.50	C. & G. S	
Omjumi Peak		56	14.78		17	08.00	G. S	Do.
Summit Peak		42	03.50		08	37.30	do	Do.
Twin Peak		06	39.30		13	56.30	do	Do.
Wellington Mountain		51	59.90		31	40.60	Wheeler	Final Rept.
	39°-40°			121°-122°				
Big Bar Hill	39	46	32.70	121	25	40.00	G. S	Bull. 122.
Chico		43	25.20		50	51.30	do	Do.
Marysville Butte		12	15.70		49	15.40	do	Do.
Pike County Peak		38	24.30		12	10.00	do	Do.
Rock Mountain		03	28.00		13	58.00	do	Do.
	38°-39°			119°-120°				
Cary Peak, Monument Peak	38	44	13.42	119	52	21.90	C. & G. S	
Dunderberg Peak		03	43.20		16	16.60	Wheeler	Final Rept.
Dardanelles Cone		24	11.50		52	20.70	G. S	Bull. 122.
Elephant Mount		39	40.00		59	54.00	Wheeler	Final Rept.
Freels Peak, Jobs Peak		51	21.79		54	01.84	C. & G. S	
Highland Peak		32	31.94		45	21.40	G. S	Bull. 122.
Leviathan		40	54.70		36	43.70	do	Do.
Silver Mountain:								
North Peak monument		33	56.66		45	29.68	C. & G. S	
South Peak monument		32	31.94		45	21.31	do	Do.
Sonora		21	08.25		38	09.18	G. S	Bull. 122.
Stevens Mountain		43	52.90		58	44.40	Wheeler	Final Rept.
Sweet Water		26	07.60		18	19.60	C. & G. S	
	38°-39°			120°-121°				
Alder Hill	38	37	40.00	120	16	40.84	G. S	Bull. 122.
Bald Mountain		54	09.20		42	19.20	do	Do.
Baltic Peak		41	33.60		30	57.00	do	Do.
Bear Mountain		01	08.50		35	08.40	do	Do.
Blue Mountain		20	26.20		21	55.00	do	Do.
Buena Vista		16	06.80		54	51.80	do	Do.
Crossman		27	49.20		32	01.00	do	Do.
Jackson		20	18.30		43	17.40	do	Do.
Joaquin		08	15.20		41	24.90	do	Do.
Mokelumne Peak		32	12.12		05	41.34	do	Do.
Pine Hill		43	04.40		59	26.70	do	Do.
Pyramid Mountain		50	32.60		09	20.60	Wheeler	Final Rept.
Robb Peak		55	24.30		24	14.00	G. S	Bull 122.
Round Top		39	43.63		00	04.99	C. & G. S	
Sugar Loaf		34	43.00		56	59.30	G. S	Do.
Capitol		34	30.70		29	38.10	do	Do.

CALIFORNIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	°	′	″	°	′	″		
	38°-39°			122°-123°				
Helena	38	40	04.26	122	38	01.41	C. & G. S	
Sulphur Peak		45	46.74		50	40.84	do	
Vaco		22	27.02		05	05.61	do	
	38°-39°			123°-124°				
Ross Mountain	38	30	13.03	123	07	09.77	do	
Sanel		56	48.23		13	00.87	do	
	37°-38°			118°-119°				
McBride Peak	37	50	08.00	118	21	12.60	Wheeler	Final Rept.
Morgan Mount		24	07.20		43	46.90	do	Do.
Waucoba Peak		01	07.80		00	23.20	do	Do.
White Mountain:								
North summit		50	13.77		21	26.34	C. & G. S	
South summit		37	57.60		15	22.10	do	
	37°-38°			119°-120°				
Chiquita Peak	37	20	46.80	119	25	31.80	Wheeler	Do.
Clark Peak		41	42.00		25	44.10	G. S	Bull. 122.
Cloud Rest		45	53.20		29	11.80	Wheeler	Final Rept.
Conness		57	55.97		19	18.10	C. & G. S	
Cottonwood Peak		55	30.90		44	07.30	G. S	Bull. 122.
Dana		53	54.30		13	17.40	C. & G. S	Do.
Deadwood Peak		18	36.70		41	00.20	Wheeler	Final Rept.
Devils Peak		31	40.20		44	26.90	G. S	Bull. 122.
Engineer Peak		49	55.00		23	35.00	Wheeler	Rept. '79.
Green Mountain Peak		15	43.60		59	19.60	do	Do.
Hoffman		50	43.50		30	39.20	G. S	Bull. 122.
Lyell		44	16.60		16	19.00	do	Do.
Merced Mountain		37	54.90		23	30.60	Wheeler	Final Rept.
Pilot Peak		45	39.80		56	10.90	G. S	Bull. 122.
Wade Peak		51	08.50		47	16.90	Wheeler	Final Rept.
	37°-38°			120°-121°				
Big Canyon	37	58	01.50	120	07	13.00	G. S	Bull. 122.
Big Hill		49	37.30		34	08.80	do	Do.
Bullion Peak		33	27.60		04	33.70	do	Do.
Moccasin Peak		48	12.50		19	43.00	do	Do.
Schultz Mount		26	33.10		08	32.90	Wheeler	Final Rept.
	37°-38°			121°-122°				
Hamilton	37	20	23.00	121	30	31.35	do	Do.
Mount Diablo		52	48.70		54	51.95	C. & G. S	
San Jose, mission church		32	00.08		54	10.27	do	
Santa Clara, Catholic spire		20	49.00		56	26.00	do	
	37°-38°			122°-123°				
Bald	37	52	56.19	122	13	20.48	G. S	Do.
Lawson Hill		56	34.00		11	36.00	do	Do.
Monument South		50	55.88		11	35.52	do	Do.
Mulholland Hill		51	26.00		08	36.00	do	Do.
Redwood Peak		49	00.00		10	37.00	do	Do.
Rocky Island		53	42.00		21	21.00	do	Do.
Striped Hill		56	49.00		17	17.00	do	Do.
Yerba Buena		48	30.00		21	59.00	do	Do.
	36°-37°			117°-118°				
Maturango Mountain	36	06	56.30	117	29	49.90	Wheeler	Do.
New York Butte		38	40.80		55	56.40	do	Do.
Telescope Mountain		09	52.40		05	27.20	do	Do.
Wahguyhe Mountain		56	03.50		06	15.60	do	Do.
	36°-37°			118°-119°				
Corcoran Mount	36	31	14.00	118	14	23.80	do	Do.
Olancha Peak		15	43.80		07	10.20	do	Do.
Thunder Mountain		04	52.20		34	40.70	do	Do.
Whitney Mount		34	33.00		17	32.00	do	Do.
	36°-37°			119°-120°				
Fresno	36	43	31.22	119	47	19.50	do	Repts. '79, '80
	35°-36°			117°-118°				
Pilot Knob	35	23	32.10	117	13	49.70	do	Final Rept.
	35°-36°			118°-119°				
Camp Weldon (mountain)	35	40	01.00	118	17	05.00	do	Do.
Cooks Point (mountain)		37	09.00		26	30.40	do	Do.
Nichols Point		37	00.50		18	05.20	do	Do.
Owens Peak		44	05.40		00	00.50	do	Do.
Pahute Peak		28	37.60		21	49.80	do	Do.
Sunday Peak		46	48.50		35	17.30	do	Do.
Tehachapai Double Peak		01	47.00		29	25.50	do	Do.
Tehachapai Mount		02	21.30		34	35.60	do	Do.
Grizzly Peak		05	52.70		50	54.70	do	Do.

CALIFORNIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	34°-35°			117°-118°				
	°	′	″	°	′	″		
	34	01	51.60	118	28	37.10	G. S	Bull. 122.
		00	58.00		46	54.00	do	Do.
		01	14.00		17	52.00	do	Do.
nio Peak		17	06.20		39	14.10	Wheeler	Final Rept.
		03	17.00		51	06.00	G. S	Bull. 122.
ry		13	49.00		14	10.00	do	Do.
		03	32.00		04	09.00	do	Do.
	34°-35°			118°-119°				
tment Peak	34	14	49.80	118	06	54.80	Wheeler	Final Rept.
		07	20.00		08	57.00	G. S	Bull. 122.
alaga) Mountain		04	33.50		39	17.20	Wheeler	Final Rept.
ando Peak		19	39.30		36	01.90	do	Do.
e		16	00.00		14	19.60	do	Do.
Hill		00	48.40		01	14.50	do	Do.
	34°-35°			119°-120°				
ount	34	48	43.90	119	08	52.60	do	Do.
anite Mountain		36	34.00		07	55.10	do	Do.
	33°-34°			116°-117°				
	33	13	56.40	116	54	14.00	G. S	Bull. 122.
to Mountain		49	07.90		42	22.20	Wheeler	Final Rept.
		00	25.10		58	17.80	G. S	Bull. 122.
	33°-34°			117°-118°				
gs	33	57	36.10	117	16	54.00	do	Do.
		12	04.40		04	00.90	do	Do.
		09	32.00		00	18.00	do	Do.
tte		43	21.00		07	28.00	do	Do.
		36	03.10		20	39.80	do	Do.
b		12	38.10		11	06.50	do	Do.
		09	42.30		19	23.80	do	Do.
		19	13.20		08	08.50	do	Do.
es, SE. base (1890)		47	28.38		56	36.08	C. & G. S	Do.
		26	34.50		23	30.00	G. S	Do.
		17	54.40		16	14.70	do	Do.
		30	39.30		44	06.80	do	Do.
		21	44.80		29	45.50	do	Do.
in		36	15.40		48	46.90	do	Do.
		54	43.90		44	21.08	C. & G. S	Do.
		42	32.40		32	07.00	G. S	Do.
Mountain		42	31.00		32	04.00	Wheeler	Rept. '79.
		06	25.90		09	22.20	G. S	Bull. 122.
		13	31.40		22	05.30	do	Do.
	33°-34°			118°-119°				
Hill	33	44	39.20	118	20	07.80	Wheeler	Final Rept.
		59	24.00		00	14.00	G. S	Bull. 122.
	32°-33°			116°-117°				
	32	56	42.20	116	36	26.70	do	Do.
		41	41.00		56	14.00	do	Do.
	32°-33°			117°-118°				
	32	58	47.40	117	07	02.00	do	Do.
		48	39.90		01	58.00	do	Do.
transit		43	06.00		09	40.80	C. & G. S	Rept. '84.

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REVISION

OF THE

ERICAN FOSSIL COCKROACHES

WITH

DESCRIPTIONS OF NEW FORMS

BY

SAMUEL HUBBARD SCUDDER

WASHINGTON
GOVERNMENT PRINTING OFFICE
1895

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LETTER OF TRANSMITTAL.

CAMBRIDGE, MASS., *November 7, 1893.*

SIR: I send herewith for publication as a bulletin, if acceptable to you, the manuscript of a paper, and drawings to illustrate it, upon the fossil cockroaches of North America. The paper was partially completed and most of the drawings were made at the termination of my connection with the Survey, and has since been finished in such leisure as I could command.

Yours, respectfully,

SAMUEL H. SCUDDER.

To the DIRECTOR U. S. GEOLOGICAL SURVEY,
Washington, D. C.

REVISION OF THE AMERICAN FOSSIL COCKROACHES.

By Samuel Hubbard Scudder.

INTRODUCTION.

When, in 1879, I published my Paleozoic Cockroaches,[1] in which a revision of the species of the whole world was attempted, I had seen but nineteen specimens from North America, belonging to seventeen species and seven genera. To-day more than three hundred American specimens have passed under my eye, besides fifty from the Triassic rocks and a very few from the Tertiary series; and from the Paleozoic series alone there are here recognized one hundred and thirty-two species (not including some indeterminate forms) belonging to fourteen genera. As I have published from time to time in various places, but principally in the Memoirs of the Boston Society of Natural History (collected in Vol. I of my Fossil Insects of North America), a considerable number of species, and as a still larger number have since accumulated, thanks to recent exploitation of the Carboniferous deposits of eastern America, it has seemed advisable, in publishing the new forms, to bring together, either by reference or by description and figure, the whole body of information at present available, in order to gain a place for a new departure.

Accordingly, I have interpolated the descriptions of new forms in a systematic list of all the species yet recovered from the rocks and have added such tables as may enable one the more readily to determine any new material that may come to hand and to make comparisons with such as prove their nearest allies. With the publication of this essay, moreover, all the species hitherto described will have been figured. All the additions made at the present time belong to the Paleozoic forms. Several species before described are here figured for the first time.

NEW LOCALITIES FOR FOSSIL COCKROACHES.

The recent extension of our knowledge of our Paleozoic cockroaches is very largely due to the exploitations of two localities, one in West Virginia, through the instrumentality of Mr. R. D. Lacoe, of Pittston, Pa., the other in Ohio, through the labors of Mr. Samuel Huston, of Steubenville.

---

[1] Mem. Bost. Soc. Nat. Hist., III, 23–134, pl. 2–6; Foss. Ins. N. A., I, 43–158, pl. 2–6.

The West Virginia locality is at Cassville, Monongal
far from Morgantown, and the specimens were found i
above the Waynesburg coal, in what is termed by Pr
the Dunkard Creek series, and referred very positivel
Prof. W. M. Fontaine to the Permian. The blattarian
far determined is unquestionably younger than any kn
Pennsylvania and Illinois rocks, on which we have hith
largely for our knowledge, and consists of a vast assem
which will undoubtedly be increased by further search.
fifty-six species, belonging to five genera, the bulk of th
species) to Etoblattina.

The Ohio locality lies at the edge of the township of
Wills Creek, in the near neighborhood of Steubenville, Jef
and though far less extensive and less thoroughly work
ville, has already yielded twenty-two species belonging t
of which the larger number (seventeen) belong to Etobl
others to the genera represented at Cassville by more
species.

It is a curious fact, to which I called partial attent
describing some of them, that these species represent fo
a distinct group of cockroaches of the genera Etoblat
blattina, characterized by great length and slenderness
median area, by a remarkable openness of the neuratio
of the tegmina, and by their frequently exceptional leng
ness. They comprise, indeed, nearly 75 per cent of the s
two genera at Richmond, and hardly occur elsewhere exc
ville, where they compose about 25 per cent of the speci
genera. The only occurrence of a similar form in Europ
elongata from the lower Dyas of Weissig, Saxony. The
this type of cockroaches is the characteristic feature of I
must place this fauna high in the series, as the stratigra
itself warrants. Its horizon, according to Mr. Huston,
carefully explored the location, is in the Barren Coal-me
above the crinoidal limestone.

It is remarkable that, notwithstanding the close relati
eral features of the two rich faunas of Cassville and Ri
single species has been found common to the two. One s
I formerly regarded as found in both, but a closer study
that there are in this case two very nearly allied forms,
accordingly separated in the present paper. Further t
one or two exceptions,[1] no American species has been
different places, and without exception the American sp
pletely distinct from the European.

---

[1] One of these is *Etoblattina balteata*, in which a fragment consisting of the ana
from Bellaire, Ohio, is referred to one of the tegmina (without the anal area p
ville, W. Va.

FAUNAL LISTS OF AMERICAN PALEOZOIC COCKROACHES.

The enlargement of our vision is, however, not entirely due to the new forms from Cassville and Richmond, but also to the increase in the number of species known from old horizons. Thus the Rhode Island coal field has now furnished a dozen species, including a new genus, while new localities in the Western Interior coal basin have increased their fauna to seven species, and certain additions have been made to other faunas already partially known. The following lists of faunas will prove of interest and show the geographical distribution of the species:

The Western Interior coal field.

Promylacris harei (Mo.).
Paromylacris clintoniana (Mo.).
Etoblattina clintoniana (Mo.).
venusta (Ark.).
Etoblattina occidentalis (Kans.).
Anthracoblattina americana (Mo.).
Oryctoblattina laqueata (Mo.).

The Eastern Interior coal field (Illinois).

Mylacris elongata.
anthracophila.
gurleyi.
ampla.
antiqua.
Promylacris testudo.
ovalis.
rigida.
Paromylacris rotunda.
Paromylacris ampla.
triangularis.
Lithomylacris simplex.
Archimylacris paucinervis.
Etoblattina mazona.
hilliana.
Progonoblattina columbiana.
Oryctoblattina occidua.

The Acadian coal field.

Mylacris bretonensis.
heeri.
Archimylacris acadica.
Petrablattina sepulta.

The Rhode Island coal field.

Mylacris packardii.
Microblattina perdita.
Etoblattina illustris.
scholfieldi.
clarkii.
sp.
Etoblattina gorhami.
exilis.
reliqua.
latebricola.
Gerablattina scapularis.
fraterna.

The Appalachian coal field (Pennsylvania).

Mylacris priscovolans.
lucifuga.
carbonum.
pennsylvanica.
mansfieldi.
ovalis.
Paromylacris pluteus.
Lithomylacris angusta.
Lithomylacris pittstoniana.
pauperata.
Necymylacris lacoana.
heros.
Archimylacris parallela.
Etoblattina lesquereuxii.
Gerablattina fascigera.

The Barren Coal-measures at Richmond, Ohio.

- Etoblattina fossa.
  - strigosa.
  - jeffersoniana.
  - fasciata.
  - ramosa.
  - willsiana.
  - maledicta.
  - benedicta.
  - funesta.
  - exsensa.
  - tenuis.
- Etoblattina hustoni.
  - hastata.
  - marginata.
  - gracilenta.
  - stipata.
  - variegata.
- Gerablattina apicalis.
  - richmondiana.
  - minima.
- Poroblattina longinqua.
  - ohioensis.

The Dunkard Creek series at Cassville, W. Va.

- Etoblattina lata.
  - sagittaria.
  - mediana.
  - ovata.
  - debilis.
  - balteata.
  - patiens.
  - mucronata.
  - detecta.
  - exigua.
  - residua.
  - funeraria.
  - expuncta.
  - aperta.
  - eakiniana.
  - accubita.
  - expulsata.
  - gratiosa.
  - macerata.
  - immolata.
  - mactata.
  - communis.
  - exsecuta.
  - arcta.
  - prædulcis.
  - angusta.
  - macilenta
  - rogi.
- Etoblattina expugnata.
  - obatra.
  - imperfecta.
  - secreta.
  - invisa.
  - occulta.
  - defossa.
  - recidiva.
- Gerablattina inculta.
  - perita.
  - diversinervis.
  - cassvici.
  - abdicata.
  - concinna.
  - uniformis.
  - permanenta.
  - permacra.
  - eversa.
  - deducta.
  - radiata.
  - lata.
  - rotundata.
  - ovata.
- Anthracoblattina virginiensis.
- Poroblattina gratiosa.
  - fossa.
  - complexinervis.
- Petrablattina hastata.

TABLES OF DISTRIBUTION OF AMERICAN AND EUROPEAN FOSSIL COCKROACHES.

The following table presents in a summary form the number of species of the different genera of cockroaches found in the American Paleozoic rocks in each of the different coal basins and in the two special localities in Ohio and West Virginia where the greatest number of species have been found. It summarizes the foregoing lists. The horizontal line separates the Mylacridæ and Blattinariæ.

le showing the geographical distribution of the American Paleozoic genera.

era.	Western Interior (Missouri, Arkansas, Kansas).	Eastern Interior (Illinois).	Acadian (Nova Scotia, Cape Breton).	Rhode Island.	Appalachian (Pennsylvania).	Richmond, Ohio.	Cassville, W. Va.	Total.
		5	2	1	6			14
s	1	3						4
is	1	3			1			5
ris		1			3			4
is					2			2
na				1				1
ris		1	1		1			3
	3	2		8	1	17	36	67
a				2	1	3	15	21
attina	1						1	2
tina		1						1
na	1	1						2
a						2	3	5
a			1				1	2
	7	17	4	12	15	22	56	133

ct that, with the very considerable increase shown to have been the number of known species, hardly a single one of them has nd at two distinct localities, lends importance to the right ation of the horizon at which each species has been found and robable, with the further extension of our knowledge of their ion, the advantageous use of these fossils in delicate discrimi- f the age of rock deposits. Accordingly, as a first step in tion, I have drawn up the succeeding table, showing the rela- gical age of each of the American species, the species them- ng arranged systematically, but excluding from the list, as at nimportant, the three Tertiary species. In this table I have eparated the species from the true productive Coal-measures, e the "Millstone Grit" and below the "Barren Coal-meas- o an upper and lower series, endeavoring as far as possible to latter correspond to the coals A–C, inclusive, of the Penn- series, and where the reference was at all doubtful to indicate able by a mark of interrogation instead of the usual cross.

Horizontal distribution of the American pre-Tertiary cockroaches.

Species.	Millstone Grit.	Lower Productive Coal-measures.	Upper Productive Coal-measures.	Barren Coal-measures.	Permian.	Trias.
Mylacris packardii		?				
bretonensis			?			
elongata		×				
anthracophila		×				
gurleyi		×				
ampla		×				
priscovolans		×				
heeri			?			
antiqua		×				
lucifuga			×			
carbonum		×	×			
pennsylvanica		×				
mansfieldi		×				
ovalis		×				
Promylacris harei				×		
testudo		×				
ovalis		×				
rigida		×				
Paromylacris rotunda		×				
ampla		×				
triangularis		×				
clintoniana		×				
pluteus			×			
Lithomylacris angusta			×			
pittstoniana			×			
pauperata			×			
simplex		×				
Necymylacris lacoana		×				
heros		×				
Microblattina perdita		?				
Archimylacris parallela	×					
paucinervis		×				
acadica			×			
Spiloblattina gardineri						×
triassica						×
guttata						×
marginata						×
Etoblattina clintoniana		×				
lata					×	
sagittaria					×	
mediana					×	
fossa				×		
illustris		?				
ovata					×	
scholfieldi		?				
debilis					×	
strigosa				×		
clarkii		?				
venusta	?					
balteata				?	×	
patiens					×	
mucronata					×	
detecta					×	
occidentalis			?			
exigua					×	
sp. (R. I.)		?				
jeffersoniana				×		
residua					×	
funeraria					×	
expuncta					×	
gorhami		?				
aperta					×	
fasciata				×		
ramosa				×		
willsiana				×		
lesquereuxii			×			
maledicta				×		
benedicta				×		
funesta				×		
exsensa				×		
tenuis				×		
hustoni				×		
persistens						
eakiniana					×	
accubita					×	
mazona		×				

Horizontal distribution of the American pre-Tertiary cockroaches—Continued.

Species.	Millstone Grit.	Lower Productive Coal-measures.	Upper Productive Coal-measures.	Barren Coal-measures.	Permian.	Trias.
Etoblattina expulsata					×	
gratiosa					×	
macerata					×	
immolata					×	
mactata					×	
communis					×	
sp. (Colo.)						×
hastata				×		
marginata				×		
gracilenta				×		
exsecuta					×	
arcta					×	
stipata				×		
prædulcis					×	
variegata				×		
hilliana		×				
angusta					×	
macilenta					×	
exilis		?				
rogi					×	
expugnata					×	
obatra					×	
imperfecta					×	
secreta					×	
reliqua		?				
invisa					×	
occulta					×	
latebricola		?				
defossa					×	
recidiva					×	
Gerablattina inculta					×	
perita					×	
apicalis				×		
diversinervis					×	
richmondiana				×		
cassvici					×	
abdicata					×	
concinna					×	
uniformis					×	
permanenta					×	
permacra					×	
eversa					×	
deducta					×	
scapularis		?				
fraterna		?				
radiata					×	
lata					×	
rotundata					×	
ovata					×	
minima				×		
fascigera	×					
Anthracoblattina americana		×				
virginiensis					×	
Progonoblattina columbiana		×				
Oryctoblattina occidua		×				
laqueata				×		
Poroblattina longinqua				×		
gratiosa					×	
fossa					×	
meieri						×
arcuata						×
lakesii						×
ohioensis				×		
complexinervis					×	
Petrablattina sepulta		×				
hastata					×	
æqua						×
Neorthroblattina albolineata						×
lakesii						×
rotundata						×
attenuata						×
Scutinoblattina brongniarti						×
intermedia						×
recta						×

With this may be compared the next table, in which
ilar division of the described European species, separati
zones employed by Dr. H. B. Geinitz in his Steinkohle
(1865), his Zone I (which does not come into use here, a
to be the equivalent of our Millstone Grit), being the "
Lycopodiaceen;" II, "der Sigillarien;" III, "der Calam
Annularien;" V, "der Farren;" succeeded by the Dyas
have been aided by Kliver's tabulation of the species fo
bruck basin (Palæontographica, XXIX, 264–265), whos
the "upper" and "middle" coal formation falls, Dr. Gein
near the middle of Zone IV. The Löbejün basin, he te
by its sigillarians to the middle coal formation, but is at
scarcely separable from that of Wettin, which on its par
with that of Manebach, etc., and must be regarded as of
formation. In the following table I have placed all of t
Löbejün and Wettin in Zone IV, and those of Manebac
classed them both as of the upper coal formation.

Etobl. bituminosa. mantidioides.[1] johnsoni.[1] deanensis.[1] steinbachensis.[2]	Etobl. primæva.	Etobl. didyma.[3] affinis.[3] anaglyptica.[3] carbonaria.[3] dohrnii.[3] flabellata.[3] euglyptica.[3] leptophlebica.[3] parvula.[3] russoma.[3] propria. lanceolata.[3]	Etobl. didyma. intermedia. labachensis. manebachensis.	Etobl. elongata. weissigensis. dyadica. stelzneri. deichmülleri. flabellata. ornatissima.
Gerabl. scaberata.		Gerabl. geinitzi.[3] germari.[3] münsteri.[3] producta.[3]	Gerabl. clathrata. goldenbergi. mahri. weissiana. robusta.	Gerabl. rollei.
Anthracobl. incerta. winteriana. camerata. lubnensis.		Anthracobl. wagneri.[3] spectabilis[3].	Anthracobl. remigii. dresdensis. scudderi.	Anthracobl. porrecta. spectabilis ? rückerti. sopita.
			Hermatobl. kirkbyi.[4] wemmetsweileriensis.	Hermatobl. lebachensis.
Progonobl. helvetica.[1]			Progonobl. fritschii.	
		Oryctobl. arndti.[3] reticulata.[3]		Oryctobl. oblonga.
				Petrabl. gracilis.
Leptobl. insignis. exilis.[1]				

---

[1] Certainly belonging to the Middle Carboniferous and probably to Zone II.
[2] Placed here by presumption only; it may belong to the Upper Carboniferous.
[3] Belonging to the Upper Carboniferous and probably to Zone IV.
[4] Credited to the Upper Carboniferous, but perhaps belonging in Zone IV.

Finally, the following table may be of interest, in whi attempt is made to correlate in a summary way the de going tables. It indicates merely the presence of the of fossil cockroaches in the several periods from which whether in Europe (by the letter E in the horizons in w or in America (by the letter A). It includes all the Palæoblattariæ of the world, with the addition of the fos of North America only. The numerous Liassic form therefore omitted. For convenience the Mylacridæ ar horizontal line from the Blattinariæ, and the Neobla Palæoblattariæ.

Geological distribution of the genera of fossil cockroa

Genera.	Millstone Grit.	Lower Productive Coal-measures.	Higher Productive Coal-measures.	Barren Coal-measures.	Permian.	Tria
Mylacris		A	A			
Promylacris		A		A		
Paromylacris		A	A			
Lithomylacris		A	A			
Necymylacris		A				
Microblattina		A				
Archimylacris	A	A				
Spiloblattina						A
Etoblattina	A[1]	A E	A	A E	A E	A
Gerablattina	A	A E		A E	A E	
Anthracoblattina		A E		E	A E	
Hermatoblattina				E	E	
Progonoblattina		A E		E		
Oryctoblattina		A	E	A	E	
Poroblattina				A	A	A
Petrablattina		A			A E	A
Leptoblattina		E				
Neorthroblattina						A
Scutinoblattina						A
Zetobora						
Homoeogamia						
Paralatindia						

[1] Subject to correction as noted on pp. 60, 73.

THE RAPID INCREASE IN OUR KNOWLED

The relative increase of our knowledge of the Paleoz of Europe and America can best be shown by the fo which the number of species of each genus on each con

rst work on the subject and at the present time, are placed in
columns:

Genera.	Europe.		America.		Total.	
	1879.	1893.	1879.	1893.	1879.	1893.
	0	0	5	14	5	14
	0	0	0	4	0	4
s	0	0	0	5	0	5
is	0	0	3	4	3	4
s	0	0	2	2	2	2
a	0	0	0	1	0	1
is	0	0	2	3	2	3
	18	27	2	67	20	94
	10	11	2	21	12	32
ttina	7	11	0	2	7	13
tina	2	3	0	0	2	3
ina	2	2	0	1	2	3
na	1	3	0	2	1	5
	0	0	0	5	0	5
	1	1	1	2	2	3
	0	2	0	0	0	2
	41	60	17	133	58	193

he total number of species has thus more than trebled, the
species have increased about 50 per cent while the Ameri-
es have multiplied nearly eightfold. It should not be over-
owever, that a very different result would unquestionably
the Commentry cockroaches, which Brongniart announced
d then been found to the number of more than 600, had been
. Unfortunately not a single one has yet been described.
ble shows also the genera which are known from Europe and
and permits a ready comparison between the representation
era on the two continents. It shows that in each Etoblattina
lattina easily hold the first place and that Etoblattina is espe-
in forms, containing just about one-half the species of either
It also makes conspicuous a point to which I called atten-
first essay on Paleozoic cockroaches—that the Mylacridæ,
nearly 22 per cent of the species and five of the fourteen
America, are, so far as described forms are concerned, com-
sent from Europe.

SOME CHARACTERISTICS OF MYLACRIDÆ.

wever, it appears, is not a statement of the actual fact; for,
note on Carboniferous cockroaches published in the Comptes
he French Academy for February 4, 1889, Mr. Charles Brong-
es that Mylacridæ are as abundant as Blattinariæ at the
cality at Commentry, France, although the latter only have
een found fossil in other places in the European Coal-meas-
ngniart gives neither description nor figures in support of
ment, but points out from the uncommonly well-preserved
found at Commentry what he regards as further points of
between the Mylacridæ and Blattinariæ, drawn from the
f the thorax: the prothoracic shield of the Blattinariæ being

well rounded and narrower than the body including th while that of the Mylacridæ is broader than the stout bo of being rounded, is nearly in the form of a triangle, it

These distinctions can not be maintained for the A Although specimens of either group showing anythin tegmina are rare in the American rocks, a few have have been published, while still others are made know paper. In no case do those show a prothorax wider wings, although in some, notably in *Promylacris testud* is nearly as wide; nor in any of the Mylacridæ, where form is more common than in the Blattinariæ, is the bro advance of the middle, as must be the case if in the fo its base forward (il a presque la forme d'un triangle avant), but always behind it.

Stated broadly, the Mylacridæ are usually stouter Blattinariæ (though the species of Lithomylacris are us as most Blattinariæ), and the prothoracic shield is always, broader in proportion to its length in the M not unfrequently subtriangular, by the subangular p middle of the front border, and of the extreme sides ior margin. An excellent illustration of this is seen *rotunda* and in *Promylacris rigida* (Pl. III, fig. 1), in w form of the prothorax is very different from the transv its congener *P. testudo*. A publication of the different fo dæ alleged to be found at Commentry is therefore all desired, and it is much to be hoped that Mr. Brongnia world at an early day with further and fuller details superb collections in his hands. They can not fail to th upon our knowledge of the earlier insects. The only sp myself seen from Commentry (a photograph and a v wing) are Etoblattinæ.

Before proceeding to the special description of the forms, there are a few matters which I will consider heads, as follows:

1. The relative size of ancient cockroaches.
2. The features of a nearly complete body of a Carb roach from Illinois.
3. The hind wings of Paleozoic cockroaches.
4. Possible mimicry in Paleozoic cockroaches.
5. The European species of Etoblattina, with descri form.
6. A list of the described European Paleozoic cockro
7. The terminology of the neuration.

THE RELATIVE SIZE OF ANCIENT COCKROACHES.

:an handle many Paleozoic cockroaches without being struck
: that they are of large size. I drew attention to this in my
Cockroaches, remarking that "while the average was con-
ıbove that of existing cockroaches, none were much larger
South American species of Blabera," whose tegmina some-
in a length of 60 to 70 mm. But in the present paper a
of a fore wing is described, which, when perfect, must have
30 mm. in length. In an estimate from the then known
Paleozoic cockroaches, I stated that "the average length of
ring appears to have been about 26 mm."
en the increase in the number of species in this country has
y from the younger Paleozoic rocks, and if we were to add
: Palæoblattariæ, of still smaller size, we should find that the
gth of the fore wing in ancient American cockroaches, 133
ll, was 23.2 mm. The Mylacridæ were larger, on the average,
lattinariæ, a fact due in great part to the younger cock-
ng all Blattinariæ, for the tegmina of 29 Mylacridæ average
hile those of 104 Blattinariæ average 22 mm. only. That
ast figure is larger than the average size of living cock-
e familiar with the latter would readily venture to assert;
t to a fair test, I have estimated the average size of recent
ı the measurements given in Brunner's Système des Blat-
), the last general work on the subject. About 380 species
l in this work, but of only 239 are measurements given of
f the tegmina; where different measurements are given for
es I have uniformly chosen that for the male as in general
and where the measurements covered a range I have taken
ıean. In this way I estimate the average length of the
iving cockroaches to be 18.8 mm., which is markedly less
e of the Paleozoic forms.[1]

ever, is by no means the whole of the story. I have
lated separately the length of the tegmina for the differ-
n species from the Millstone Grit to the Trias, inclusive,
t there is a marked and regular diminution in average size
iod to another, as will appear from the following measure-
: tegmina given in millimetres:

Grit (3 species), 26 to 38, average 31.
ductive Coal-measures (39 species), 10 to 61, average 29.7.
oductive Coal-measures (12 species), 16.35 to 33, average

al-measures (23 species), 9.75 to 31.5, average 23.4.
56 species), 8.25 to 28.75, average 16.9.
pecies), 6.3 to 24, average 13.

---

estimate, though I recollected I had once made one of the same nature, I had for-
ion, and only after the above was written discovered it in my Revision of Mesozoic
re a slightly different result follows slightly different data; but I prefer to leave the

The only important doubt about the exact accurac
ment is that the fauna of the Rhode Island coal basin
12 species) is included in the Lower, when it may per
the Upper Productive Coal-measures. The average siz
Island species is 27.3 mm., and that of the species from
ductive Coal-measures without them is 30.7 mm., whil
Island species were added to the Upper series, it wou
average of that to 26.8 mm.; but this would still not di
lar succession of averages. The average size of the 5
the Productive Coal-measures as a whole is 27.4 mm.,
cisely that of the Rhode Island species alone.

I do not mean to maintain that the size of cockroa
steadily and continuously diminishing from the earlies
present, but only for that period of time which is here
also, I may add, for the later Mesozoic rocks, for I have
that the average length of the tegmina of European M
Liassic) cockroaches was 12.5 mm., which is slightly le
the species from the American Trias. It is well known
mass of Mesozoic, and especially Liassic, insects were
but the insects of the Tertiaries did not differ in this
noticeable degree from those now living.

I have further tabulated the relative length of the
different genera separately, both as a whole and in each
in which they occur. They may be shown as follows, th
given in millimeters, and showing both range and avera

Average length of tegmina in the genera of American fossil

Genera.	Mill-stone Grit.	Lower Productive Coal-measures.	Upper Productive Coal-measures.	Barren Coal-measures.	Permian.	
Mylacris		26.50-42.00 Aver. 31.10	16, 35-33.00 Aver. 25-60			
Promylacris		19.00-29.00 Aver. 25.30		17.50		
Paromylacris		21.00-42.00 Aver. 28.50	30.00			
Lithomylacris		24.00	26.00-29.25 Aver. 27.20			
Necymylacris		25.00-48.00 Aver. 36.50				
Microblattina		8.00				
Archimylacris	26.00	26.00-30.50 Aver. 28.25	23.00			
Spiloblattina						15 A
Etoblattina	29.00	14.25-61.00 Aver. 26.40	25.00-32.00 Aver. 28.50	14.00-31.00 Aver. 25.50	11.75-28.75 Aver. 17.60	12 A
Gerablattina	38.00	18.00-41.00 Aver. 29.50		9.75-25.00 Aver. 18.30	10.00-25.50 Aver. 16.60	
Anthracoblattina		30.00			12.00	
Progonoblattina		20.75				
Oryctoblattina		19.00		21.00		
Poroblattina				11.00-22.00 Aver. 16.50	13.50-16.75 Aver. 15.60	10 A
Petrablattina		13.00			8.25	
Neorthroblattina						8 A
Scutinoblattina						A

This table shows that in general, especially where the species were numerous, the same rule holds remarkably under each genus, the average size decreasing with the lapse of time. The only noticeable exception is in the two divisions of the Productive Coal-measures, where, in the genera Paromylacris, Lithomylacris, and Etoblattina, the averages are reversed from what they should be under the rule. The other exceptions, as in Oryctoblattina, and in part in Petrablattina, and in Archimylacris, are where only a couple of species or so are concerned. The relative average size of the species of the different genera is also shown, and proves that the average size of every genus of Mylacridæ is larger than that of any of the other genera excepting only Archimylacris, which, as I have elsewhere pointed out, was the most antique type of all cockroaches. The table further lends support to the view that the Dunkard Creek series of rocks (at Cassville) are older than the Barren Coal-measures, and should be referred to the Permian, since in each of the three genera represented in both beds the average size of the species from the Dunkard Creek series is the smaller.

II. THE BODY OF A PALEOZOIC COCKROACH.

Pl. XII, figs. 8–11.

Through the kindness of Prof. Josua Lindahl, of the Illinois Museum of Natural History, I have been permitted twice to examine a very curious specimen, which I regard as the principal part of the body of a wingless cockroach from the Coal-measures of Illinois. It is entirely freed from the matrix, and, with the exception of the head and appendages of the body, represents the complete body of a cockroach, probably in very much of its original form. The proportions of the abdomen indicate that it was in all probability a female, but whether a larval form or a mature individual with the wings removed is quite impossible to say. If a female, the ovipositor, said by Brongniart to be characteristic of Paleozoic cockroaches, is broken away. Fig. 9 is presumed to represent the ventral and fig. 11 the dorsal aspect of the creature, partly from the form of the upper surface of the metathorax, as shown particularly in fig. 10, and from the fact that there are what are apparently scars at the position of the mesothoracic coxæ on the ventral surface, which, however, do not clearly appear in the figure. The abdomen is composed of eight complete segments, similar dorsally and ventrally, as may best be seen by fig. 10. The first segment encircles the whole body externally, and is not covered at the sides by the projecting margins of the metathorax, as in modern cockroaches. There are, however, several anomalies in the abdomen and difficulties to be explained. Fig. 11 represents the dorsal aspect with the only clear indications, as shown also in fig. 10, of the separation of the mesothorax and metathorax, but with a distinct indication throughout of the first abdominal segment, which scarcely shows on the ventral aspect (fig. 9), and the difference in the separation of which from the the dorsal and ventral surfaces is clearly shown in fig. and seventh abdominal segments are the only ones wh distinct upon both margins throughout the entire circu as shown in all the figures. The third and fourth segme distinct on the dorsal surface, but on the ventral (fig. 9) between the third and fourth is lost, excepting on th it is as distinct as above; possibly the remaining porti segment may be broken away. Dorsally, the fifth segme by an oblique fold, which does not appear elsewhere, apparent separation of the segment into two subsegn indications, which only traverse a portion of the b appear, and the relation of the other parts to one ano clear that there is here no true subsegmentation. The sion of the eighth segment in fig. 10 is explained by th which show that this segment is made up in the original irregular bosses which may have terminated (as Brong for the better preserved specimens of fossil cockroaches measures of Commentry, France) with a long ovipositor, of our living Phasmidæ.

The abdomen is thus seen to differ from that of mode in being composed of eight complete and tolerably unif no distinct separation, as may best be seen in fig. 10, ventral scutes, and in consequence there are as many sal, excepting only that the first segment is separated thorax distinctly only on the dorsal surface, as is best This may be the first step in a distinction between t ventral surfaces as seen in modern cockroaches. But ther indication of something similar in the fold upon the of the fourth abdominal segment, indicating a divisio ments at this point. In this case, however, the differen dorsal and ventral surfaces would appear to result fro one of the dorsal scutes rather than from a suppressio ventral.

As it is impossible to determine to what genus this have belonged, or even to what family of ancient cockro is given to it at present. It was obtained at Olney, Ill Phillips, and was presented by him to the Illinois Muse History, where it bears the number 4941.

I. THE HIND WINGS OF PALEOZOIC COCKROACHES.

Pl. XII, figs. 4–7.

he larger part of the remains of fossil cockroaches consist of
ıa, but in a few instances the hind wings have been preserved,
by themselves, sometimes in connection with the tegmina;
ew additional forms are illustrated in the present paper, it
ell to draw general attention to them more carefully than has
one.

ious occasions I have mentioned the undoubted fact that the
ind wings of Paleozoic insects harmonized in neuration more
than they do in living insects, and have also stated that even
tion in texture, such as exists to-day in many groups (especially
, had scarcely begun, the neuration being always equally
n both wings. That this latter statement is not absolutely
aleozoic insects, that their fore wings were of somewhat
ture or tougher consistency than the hind pair, must, I think,
d, when we note how extremely rarely the hind wings are
as compared with the fore wings; nevertheless, when they
ved, no such difference is discernible.

ely the hind wings of Paleozoic cockroaches are known may
made apparent by the statement that up to the present
have been figured for only three European species, two of
and one of an undetermined form (*Blattina latinervis*) and
nerican, namely, one species each of Promylacris, Paromy-
himylacris, Oryctoblattina, and Etoblattina, to which are
e present paper one each of Mylacris and Etoblattina, and
of independent wings, one of which may be referred to
, while the other, though nearly perfect, is very problemat-
e which are preserved in connection with other parts rarely
beside the apical third, so that our knowledge of them is
ed than it ought to be when they are thus so much more
erminable. From this meager showing the following state-
be made, though they are offered with some hesitation,
agmentary material on which they are based:

probable from the general harmony between the fore wings
nd pair that a difference somewhat similar to that which
een the fore wings of Mylacridæ and Blattinariæ will be
e hind wings. In no case, however, have we yet found the
gin of the hind wing preserved in any of the Mylacridæ; but
of the Blattinariæ we see the mediastinal area stretching
arrow vittate field much more than half way to the apex of
uch narrower than is usual in the fore wing; while analogy
us to infer that in the Mylacridæ it was relatively much
perhaps to a greater or less degree triangular. This is my
for believing it probable that the wing figured on Pl. XII,

fig. 5, is one of the Blattinariæ, to which is opposed the close resemblance it bears, in parts which allow of any comparison at all, to Promylacris, its excessive size, and the general composition of the fauna from which it comes, as will be stated later in the special description of this wing.

As a general rule the internomedian area, on the contrary, appears to have been broader than in the tegmina, and did not possess the special character of distinction from the mode of branching in the other areas which it had in the fore wing. In the latter, for instance, the branches of this area are generally much more delicate than in the other areas, and are usually more widely separated and very uniform. In all the hind wings where this area is preserved the branches are in no way more delicate than those of the other areas, while, with the exception of Mylacris, the branches are as close as elsewhere, and usually somewhat or considerably irregular. Curiously, in Mylacris the general appearance of this area is precisely as in the fore wing, differing apparently only in being narrower and tapering less rapidly. The other intermediate areas of the hind wing differ from their general character in the fore wing in having the branches more of an arborescent type, in which it is difficult to say what course the main vein with its irregular or regular breaking up takes, or on which side, if not on both, the principal branches are thrown off from the main stem. In general the division of the scapular and externomedian areas on the border is at or close to the apex of the wing, which seems always to lie, not at the end of the middle line of the wing, but somewhere in its upper half, so that the wing is less symmetrical in form than the fore wing.

Whether we shall ever be able to determine the characteristics of different genera in the hind wings may be deemed doubtful; certainly not until a vast deal more is known about them than now. Possibly when the rich Blattarian fauna of Commentry has undergone the investigation it awaits at the hands of Mr. Charles Brongniart, we shall be able to speak more hopefully, but at present the genus Etoblattina is the only one of which we have representatives of more than a single species.

In Etoblattina the hind wing is pointed-ovate, broadest beyond the middle, fully twice as long as broad, with very straight costa until the wing begins to narrow, and with a very full and rounded inner border, the apex being not far from the middle of the upper half of the wing. The mediastinal area is very narrow and reaches to the middle of the apical half of the wing or farther, with arcuate, very oblique branches. The scapular vein is very straight, throws off very oblique forking branches to the costal margin, first forking a little before the middle of the wing, and terminates at or above the apex. The externomedian vein is likewise straight, first branches as soon as or a little before the scapular, the branches forked or generally compound, rarely simple, and nearly or quite longitudinal; they seem to be indifferently inferior or superior, but all either one or the other. The internomedian area is very broad, generally occupying fully half the breadth of the wing in its basal half, the main vein straight or nearly straight, running obliquely to the inner margin of the wing and ending just about as far toward the apex as the mediastinal vein; the branches are all inferior, closely crowded, nearly straight and oblique, and generally simple. Of the anal area nothing can be known from present specimens, excepting what is seen in the specimen figured on Pl. XII, figs. 6, 7, which will be mentioned in its description, later in this paper.

An exception to these characters is so great in a hind wing, which I have recently figured[1] and called an Etoblattina, that I am now inclined to think it can not belong to this genus, but perhaps to Gerablattina, also found in the same beds. It is again figured here in Pl. XII, fig. 4. These exceptions consist in the form of the wing, in which the apex (which is destroyed) apparently must fall about the middle of the wing, while the inner border is much less full; in the earlier forking of both scapular and externomedian veins, the former earlier than the latter; the more arborescent or apical branching of the externomedian vein, the branches of which are both superior and inferior, and in the different character of the internomedian area, which is by no means so broad as in all the Etoblattinæ known, and has only a few branching, very oblique veins. The anal area is here preserved, and is remarkable as being but a shorter form of the mediastinal type.

The hind wing of Archimylacris, so far as we know it, is again somewhat different. The form would appear to be the same as in Etoblattina and the mediastinal area similar but much longer. The scapular vein, however, is very different, and the few branches are distant, inferior, and include the apex at the margin, extending, indeed, farther below the apex than above it. The externomedian vein appears to be a repetition on a lesser scale of the scapular, but more can not be said.

The peculiar character of the internomedian area in Mylacris has already been mentioned. All that can be further said of the hind wing in this genus is that the externomedian vein (excepting that the branches are superior and not inferior) appears to be a repetition of the same area in the fore wing and to bear a similar relation to the internomedian area.

In Paromylacris the scapular and externomedian areas appear to be extremely similar to their condition in Etoblattina, the division line between them also falling at just about the pointed apex of the wing, which, so far as can be seen, has a similar form.

Probably the same is also true of Promylacris, though this is entirely uncertain from the slight fragment of the apex which is preserved, for, on the contrary, it may be entirely similar to the wings figured on Pl. XII, fig. 5.

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[1] Bull. U. S. Geol. Surv., No. 101, pl. 2, Fig. k.

IV. POSSIBLE MIMICRY IN PALEOZOIC COCKROACHES.

Before finishing these introductory remarks I wish to draw attention to a topic unusual in such a connection. In studying protective resemblance and mimicry among living animals, the exceedingly common occurrence of these phenomena has often forced upon me the conclusion that they have not been limited in their scope to recent times, but must have existed in past epochs and even, to some extent at least, in very remote epochs. This is a natural conclusion from the universality of their present occurrence. Hardly an animal exists that does not actually owe its existence to some feature or features in its form or coloring. This statement will doubtless appear strong to those who are unacquainted with or have not considered the facts. Let me reenforce it in the words of its latest exponent, M. Félix Plateau, the well-known professor in the University of Gand:

> The thesis I wish to sustain, in agreement with naturalists of high merit, would demonstrate that the phenomena [of mimicry] are general; that is to say, that there are hardly any animals which, in at least some one of the stages of their existence, do not have recourse to imitation; that in our own countries, in temperate Europe, in Belgium itself, the zoologist who is really an observer meets at every step cases of dissimulation which are every whit as striking as [ne le cédent en rien] those which tropical nature offers us.[1]

The arguments I have used in my own essay on the subject[2] attempt to show that in the very nature of things protective resemblance must prevail in a world where creatures are the food of others, and where they escape destruction only when less easily or less frequently seen by their predaceous foes than their fellows. From this standpoint it would be difficult to refrain from the logical conclusion that protective resemblance was nearly or quite as much a feature of past life as it is of present.

Naturally, since coloring forms the most important or the most common part of protection, proof of such protection can not be derived from the fossils. But pattern of markings is also a conspicuous element of protection in existing types, and in a few fossils among insects we can detect markings of a precisely similar nature to some which in existing insects can be proved protective; but here habit and association are often necessary factors, and these can usually only be inferred in the extinct types, but inferred in some instances with considerable reasonableness. The examples which I have in mind are all drawn from Tertiary faunas; but I refer to the matter here since it seems to me fairly reasonable to look upon some forms of Carboniferous cockroaches as probably imitative and thereby protective. The first cockroach wing ever described was first described as a fern leaf, and in all or nearly all the localities where their remains have been found they are associated with fern-leaves in immense abundance. While searching for their remains in the Permian deposits at Cassville I was much struck by this resemblance and was repeatedly obliged to use the glass to determine whether it was the wing of a cockroach or the frond of a fern I had uncovered, and the instances are not rare where they agree completely in size. The general distribution of the nervures is to cursory view the same in each, and the form is often nearly identical. Only the differentiation of the anal area in the cockroach wing at once distinguishes them, but this is really a feeble point and would often be noticed only by an expert. To show how close the general resemblance is I place here side by side figures of a cockroach wing and a fern frond found associated in the same beds[1] and ask whether it is not plausible to suppose that the intimacy of the resemblance is due, as such an instance of associated organisms would now be regarded if the color agreed, to the action of selection in producing protective resemblance. The ordinary color of the tegmina of existing cockroaches is brown or testaceous, yet there are not wanting numerous examples, at least in the tropics, where they are as green as the leaves of ordinary vegetation.

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[1] Bull. Acad. Roy. Belg. (3), XXIII, 92 [1892].

[2] Atlantic Monthly, Feb., 1889; Butt. east. U. S. and Canada, 710-720.

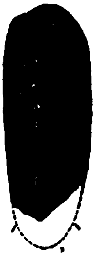

FIG 1.—*Gerablattina permanenta.*

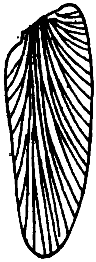

FIG. 2.—One of the pinnæ of *Neuropteris odontopteroides.*

V. THE EUROPEAN SPECIES OF ETOBLATTINA, WITH DESCRIPTION OF A NEW FORM.

For the convenience of students a first essay is here made to tabulate the European species of Etoblattina, the genus of cockroaches most numerously represented in Carboniferous times, both in Europe and America. All the species described up to the present time are introduced, together with a new British species, a description of which is added. It will be seen that Deichmüller's var. *stelzneri* (regarded by him as a form of *E. flabellata*), and Geinitz's var. *dyadica* (regarded by him as another form of the same), are considered distinct species; and that *E. rollei* Deichm. is not included, this last being more probably a Gerablattina. *E. peachii* Woodw. is also omitted, as the tegmina are undeveloped, and therefore present no features which could admit it into the table. On the other hand, *Blattina intermedia* Gold., formerly described by me as a Gerablattina, has had new light thrown upon it by Kliver, showing it to be an Etoblattina, and it is accordingly introduced here.

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[1] Specimens showing far closer resemblance could easily be selected, but the time at my disposal when the illustration was needed did not admit of a better choice. The plant is from the roof shales of the Waynesburg coal, above the "roof coal" at Cassville and , copied from one of the figures in Fontaine and White's Permian Flora (Rep. Penn. Geol. Surv., PP). The insect comes from the shales which separate the "roof coal" from the main coal beneath, at the same locality.

Table of the European species of Etoblattina.

a^1. Tegmina broad, at most but little more than twice as long as broad, the mediastinal area usually broad at base, here generally occupying a third or more of the tegmina.

b^1. Mediastinal area tapering gradually, and relatively long, more, often much more, than four times as long as greatest breadth.

c^1. Relatively slender, the tegmina distinctly more than twice as long as broad.

d^1. Apical margin divided between the scapular and externomedian areas. 1. *E. labachensis.*

d^2. Apical margin divided between the externomedian and internomedian areas .... 2. *E. intermedia.*

c^2. Tegmina broad, not more than twice as long as broad, the immediate apex occupied by the externomedian branches.

d^1. Tegmina less than twice as long as broad; mediastinal area reaching nearly to the middle of the distal half of the tegmina; externomedian vein first forking not before the middle of the tegmina.. 3. *E. propria.*

d^2. Tegmina twice as long as broad; mediastinal area hardly extending beyond the middle of the tegmina; externomedian vein first branching far before the middle of the tegmina......... 4. *E. deichmülleri.*

b^2. Mediastinal area tapering rapidly and relatively short, less, often much less, than four times as long as basal breadth.

c^1. Internomedian area long and numerously branched, falling but little short of the apex of the tegmina.

d^1. Humeral angle prominent, the tegmina less than twice as long as broad. 5. *E. steinbachensis.*

d^2. Humeral angle roundly excised, the tegmina more than twice as long as broad... 6. *E. primæva.*

c^2. Internomedian area relatively short and with few branches, falling far short of the apex of the tegmina.

d^1. Mediastinal vein with frequent branches; scapular branches few, mostly forked deeply or compound..................... 7. *E. deanensis.*

d^2. Mediastinal vein with infrequent branches; scapular branches numerous, mostly simple or only apically forked......... 8. *E. lanceolata.*

a^2. Tegmina relatively slender, rarely less than two and a half times as long as broad, the mediastinal area usually rather slender and ribbon-shaped, not or scarcely broader at base than in the middle, and rarely occupying more than a fourth of the basal width of the tegmina.

b^1. Tegmina distinctly less than three times as long as broad.

c^1. Internomedian area long but far from attaining the apex of the tegmina, rarely prolonged by distinct sinuosity of the main vein.[1]

d^1. Mediastinal area extending well beyond the middle of the tegmina.

e^1. Externomedian vein first branching beyond the middle of the tegmina. 9. *E. carbonaria.*

e^2. Externomedian vein first branching far before the middle of the tegmina.

f^1. Tegmina of large or medium size, well rounded at apex; externomedian area expanded and on the margin as important as the scapular.

g^1. First scapular branch arising far before the succeeding, near the middle of the basal half of the tegmina; internomedian vein scarcely sinuate .... 10. *E. russoma*

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[1] This is only conjectural in *E. mantidioides*, but indicated by the parts preserved.

Table of the European species of Etoblattina—Continued.

g^2. First scapular branch arising but little before the middle of the tegmina and at ordinary distance before the succeeding; internomedian vein strongly sinuate .... 11. *E. dyadica.*

f^2. Tegmina of small size, subacuminate at apex; externomedian area compressed and on margin of much less importance than the scapular.. 12. *E. parvula.*

d^2. Mediastinal area scarcely if at all surpassing the middle of the tegmina.[1]

e^1. Scapular and externomedian veins first branching at nearly the same point.[2]

f^1. Primary offshoots of the externomedian vein numerous.

g^1. Course of the externo-internomedian interspace gently oblique, arcuate...................................... 13. *E. manebachensis.*

g^2. Course of the externo-internomedian interspace strongly oblique, sinuous.. 14. *E. ornatissima.*

f^2. Primary offshoots of the externomedian vein only two or three in number .... 15. *E. anthracophila.*

e^2. First branching of the externomedian vein far beyond that of the scapular .... 16. *E. mantidioides.*

c^2. Internomedian area very long, nearly reaching the apex, or reaching the apical margin, often prolonged by distinct sinuosity of the main vein.

d^1. Mediastinal area extending well beyond the middle of the tegmina.

e^1. Scapular vein first branching far beyond the middle of the tegmina. 17. *E. johnsoni.*

e^2. Scapular vein first branching before, often far before, the middle of the tegmina.

f^1. All the internomedian branches simple or simply forked.

g^1. Scapular vein first branching at some distance before the externomedian .... 18. *E. dohrnii.*

g^2. Scapular vein first branching but little before the externomedian.

h^1. Mediastinal and scapular branches with normal obliquity; internomedian branches frequent, with normal obliquity. 19. *E. didyma.*

h^2. Mediastinal and scapular branches very longitudinally oblique; internomedian branches exceedingly few and longitudinally oblique....................................... 20. *E. bituminosa.*

f^2. Some apical branches of the internomedian vein compound. 21. *E. anaglyptica.*

d^2. Mediastinal area hardly reaching the middle of the tegmina.

e^1. Scapular vein in the middle of its course receding from the margin to reach the middle line of the tegmina...... 22. *E. leptophlebica.*

e^2. Scapular vein in the middle of its course hardly receding from the margin and nowhere nearly reaching the middle line of the tegmina .... 23. *E. flabellata.*

b^2. Tegmina distinctly more than three times as long as broad; internomedian area long and slender.

c^1. Internomedian area not nearly reaching the apex of the tegmina, with no extension by the distal sinuosity of the main vein.

d^1. Tegmina less than 20 mm. long; course of the main scapular vein distinctly sinuous, and at one point nearly reaching the middle line of the tegmina.................................. 24. *E. affinis.*

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[1] This is conjectural but probable in *E. ornatissima* by the brief extent of the scapular area.

[2] Conjectural again, but probable, with *E. ornatissima.*

Table of the European species of Etoblattina—Continued.

d^2. Tegmina more than 30 mm. long; course of the main scapular vein nearly or quite straight, at no point nearly attaining the middle line of the tegmina.
  e^1. Tegmina subequal on distal half (apparently; the only specimen is broken), the externomedian vein with regular offshoots from the middle of the tegmina outward .... 25. *E. euglyptica.*
  e^2. Tegmina tapering considerably throughout the distal half, the externomedian branches all arising close to the apex from two stems which unite at or before the middle of the tegmina .... 26. *E. elongata.*
c^2. Internomedian area nearly reaching the apex of the tegmina by the distal sinuosity of the main vein.
  d^1. Externomedian vein first forking well before the middle of the tegmina, with many branches; distal portion of anal area with numerous branches .... 27. *E. stelzneri.*
  d^2. Externomedian vein first forking at some distance beyond the middle of the tegmina, with few branches; distal portion of anal area with few branches .... 28. *E. weissigensis.*

ETOBLATTINA DEANENSIS sp. nov.

Pl. XII, figs. 1, 3.

The fore wing has a very regular elongate oval form, tapering with considerable regularity beyond the middle third of the tegmina, the anal area by its fullness interfering a little with the regularity; it is a little more than two and a quarter times as long as broad; the costal margin has a very regular and moderately convex curve, while the inner margin, beyond the fuller and more convex anal area, is nearly straight; the tip is imperfect in the two specimens known. The veins originate slightly above the middle of the tegmina and at first all curve upward, but not so strongly as in *E. primæva*, to which this species is most nearly allied, so that the externomedian vein passes more nearly through the middle of the tegmina. The mediastinal vein passes in a scarcely sinuous course to somewhat beyond the middle of the front margin, emitting about half a dozen nearly straight, simple or deeply forked branches. The scapular vein is broadly and gently sinuous, extending to the apical margin a very little above the apex, begins to fork before the middle of the proximal half of the tegmina, and has four subequidistant branches, of which the first is compound, the others forked or simple. The externomedian vein first forks near the middle of the tegmina, where it divides into two very similar, weakly arborescent, longitudinal stems carrying about ten or a dozen veinlets to the apical and to the outer portion of the inner margin. The internomedian vein is very regularly and rather gently arcuate except for a slight apical sinuosity which carries it nearly to the apical sixth of the tegmina, and has about five nearly straight branches, some of the basal ones simply or doubly forked. The anal furrow is not very deeply impressed, very regularly but not very strongly arcuate, and ends at about the middle of the

The anal veins consist of two sets, rather widely separated at the inner set consisting of a several-branched main stem sub- o the anal furrow, the outer to four or five simply or doubly pproximated, slightly divergent nervules, more nearly longi- an the other set.

specimens known, one with its reverse, are coal black; the its reverse is nearly perfect, having lost only the shoulder and margin; the other specimen consists of two tegmina, of one nly the base and the anal area is preserved and which lies concealing the reversed face of the other, of which the basal d considerable of the apex is lost. Excepting in the anal and dian areas the veins are pronounced, being deeply incised; in omedian area they are very delicate. Toward the apex of the n exceedingly delicate reticulation can be detected in the s, which gives way in the center of the tegmina to a very close ulled cross-lines, and become in the scapular area parallel to margin.

of the tegmina, 38 mm.; breadth, 13.25 mm.

specimens differ from each other in hardly anything but the or complexity of the several branches of the main veins, par- the upper stem of the externomedian vein and the princi- es of the internomedian vein. In one, however, the costal pears to be distinctly more arcuate than in the other.

cies is plainly most nearly allied to *E. primæva*, from which n its more elongate form, apical tapering, the lack of an sal branch of the scapular vein, the far greater importance er branching of the externomedian vein, the narrower and ernomedian area and its simpler apical branching, the more ve of the anal furrow, the entire system of anal veins, and ourse of all the main veins through the middle area of the

men with reverse, fig. 1, comes from Foxe's bridge, in the Dean, Gloucester, England. The other was collected by Crump meadow, in the Forest of Dean. Both are in the Mr. R. D. Lacoe, in which they bear the number 2132 *a–b*, *c*.

OF THE DESCRIBED EUROPEAN PALEOZOIC COCKROACHES.

es in this list are arranged alphabetically under each genus, era are in a natural order. Several species, because too known, are not mentioned, as they can not be placed. Such *ligniperda* Kušta, from Lubná, Bohemia; *B. neuropteroides* *. rarinervis* Göpp., from an unnamed locality; *B. tischbeini* Hirschbach, Germany, and *B. venosa* Gold., from Wemmets- ish Prussia. *Etoblattina peachii* Woodw., from Kilmaurs, also omitted, as the undeveloped tegmina hardly allow it ely placed.

A list of the described European Paleozoic cockroache

Etoblattina affinis (Gold.), Löbejün and Wettin, Saxony.
anaglyptica (Germ.), Wettin, Saxony.
bituminosa (Kušta)[1], Lubná, Bohemia.
carbonaria (Germ.), Wettin, Saxony.
deanensis Scudd., Forest of Dean, Gloucester,
deichmülleri (Gein.)[2], Weissig, Saxony.
didyma (Germ.), Wettin, Saxony; Manebach, S
dohrnii Scudd., Wettin, Saxony.
dyadica (Gein.)[3], Weissig, Saxony.
elongata (Gein.), Weissig, Saxony.
euglyptica (Germ.), Wettin, Saxony.
flabellata (Germ.), Wettin and Weissig, Saxony
intermedia (Gold.), Wemmetsweiler, Rhenish P
johnsoni Woodw., Dudley, England.
labachensis (Gold.), Labach, Rhenish Prussia.
lanceolata (Sterz.), Lugau, Saxony.
leptophlebica (Gold.), Löbejün, Saxony.
manebachensis (Gold.), Manebach, Saxe-Weima
mantidioides (Gold.), Durham, England.
ornatissima Deichm., Grügelborn, Rhenish Pru
parvula (Gold.), Löbejün, Saxony.
primæva (Gold.), Saarbrücken, Rhenish Prussi
propria Kliver, Saarbrücken, Rhenish Prussia.
russoma (Gold.), Löbejün, Saxony.
steinbachensis Kliv., Steinbachthal, Rhenish P
stelzneri (Deichm.),[4] Weissig, Saxony.
weissigensis (Gein.), Weissig, Saxony.

Gerablattina clathrata (Heer), Manebach, Saxe-Weimar.
geinitzi (Gold.), Löbejün, Saxony.
germari (Gieb.), Wettin, Saxony.
goldenbergi (Mahr), Manebach, Saxe-Weimar.
mahri (Gold.), Manebach, Saxe-Weimar.
münsteri Scudd., Wettin, Saxony.
producta Scudd., Wettin, Saxony.
robusta Kliv., Wemmetsweiler, Rhenish Pruss
rollei (Deichm.),[5] Grügelborn, Rhenish Prussi
scaberata (Gold.), Altenwald, Rhenish Prussia
weissiana (Gold.), Brücken, Rhenish Bavaria.

Anthracoblattina camerata Kliv., Dudweiler, Rhenish Pruss
dresdensis (Gein.-Deichm.), Klein Opitz,
incerta Kliv., Dudweiler, Rhenish Prussia
lubnensis (Kušta),[6] Lubná, Bohemia.
porrecta (Gein.), Weissig, Saxony.
remigii (Dohrn), Cusel, Rhenish Bavaria.
rückerti (Gold.), Stockheim, Bavaria.
scudderi Gold., Wemmetsweiler, Rhenish
sopita Scudd., Weissig, Saxony.
spectabilis (Gold.), Weissig? and Löbejü
wagneri Kliv., Löbejün, Saxony.
winteriana (Gold.), Dudweiler, Rhenish P

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[1] *Blattina (Etoblattina) bituminosa* Kušta.
[2] *Blattina (Etoblattina) carbonaria*, var. *deichmülleri* Gein
[3] *Blattina (Etoblattina) flabellata*, var. *dyadica* Gein.
[4] *Etoblattina flabellata*, var. *stelzneri* Deichm.
[5] *Etoblattina rollei* Deichm.
[6] *Blattina (Anthracoblattina) lubnensis* Kušta.

A list of the described Paleozoic cockroaches—Continued.

Hermatoblattina kirkbyi (Woodw.), Fifeshire, Scotland.
lebachensis (Gold.), Lebach, Rhenish Prussia.
wemmetsweileriensis (Gold.), Wemmetsweiler, Rhenish Prussia.
Progonoblattina fritschii (Heer), Manebach, Saxe-Weimar.
helvetica (Heer), Erbignon, Switzerland.
Oryctoblattina arndti Kušta, Třemošná, Bohemia.
oblonga Deichm., Weissig, Saxony.
reticulata (Germ.), Wettin, Saxony.
Petrablattina gracilis (Gold.), Lebach, Rhenish Prussia.
Leptoblattina exilis Woodw., Dudley, England.
insignis (Gold.), Dudweiler, Rhenish Prussia.

VII. THE TERMINOLOGY OF THE NEURATION.

In explanation of the terminology here used for the neuration of the tegmina and wings of Paleozoic cockroaches, and in which I have simply followed Heer, the accompanying figure of one of the tegmina of *Etoblattina mazona* from the Carboniferous beds of Illinois is introduced, enlarged two diameters, with the veins at the base of the tegmina named, and the areas marked along the margin. These names are employed in all the descriptions.

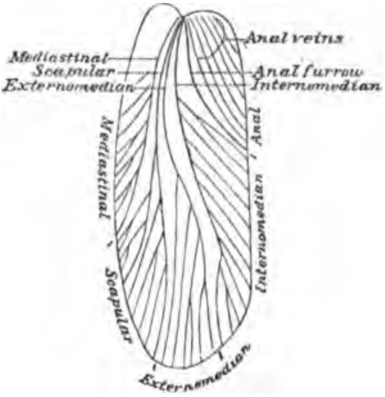

FIG 3.—*Etoblattina mazona*, with the nomenclature of the parts.

TABLE OF THE GENERA OF AMERICAN FOSSIL COCKROACHES.

This table is also applicable to the European genera, for one Paleozoic genus not yet found in America is included in it, distinguished by an asterisk following it. Leptoblattina, exclusively European, is not included, as the neuration of the tegmina is too obscure to place it.

A.[1] All six of the main veins of tegmina independent (excepting sometimes in the basal fourth of the tegmina); anal veins impinging on the hind margin .... PALÆOBLATTARIÆ.

B[1] Branches of the mediastinal vein arranged in a radiate manner, mostly springing from a common point at the base of the tegmina; mediastinal area subtriangular, uniformly tapering apically.... MYLACRIDÆ.

Table of the genera of American fossil cockroaches—Conti

c^1. All or very nearly all the branches of the mediastinal vei
the base of the tegmina.
d^1. Mediastinal and scapular areas together occupying le
tegmina.
e^1. Scapular area larger than the mediastinal ....
e^2. Scapular area smaller than the mediastinal ....
d^2. Mediastinal and scapular areas together occupying half
the tegmina.
e^1. Tegmina narrow; externomedian area small and com
expanding apically ....
e^2. Tegmina broad; externomedian area expanding apically
c^2. A number of the apical branches of the mediastinal vein a
base of the tegmina, and scarcely partaking of th
ment of the others ....
B^2. Branches of the mediastinal vein arising at regular intervals
stem; mediastinal area generally band-shaped ..
c^1. Internomedian vein long, terminating beyond, rarely at, t
outer half of the tegmina; scapular and exte
together generally covering less than one half o
d^1. Mediastinal area comparatively short, rarely exceeding,
two-thirds the length of the tegmina.
e^1. Externomedian branches inferior, so that the nervules di
side of the scapular-externomedian interspace ..
e^2. Externomedian branches superior, so that the nervules di
side of the externomedian-internomedian intersp
f^1. Scapular area extending beyond and embracing the e
tegmina by the backward sweep of the main vein
area comparatively small ....
f^2. Scapular area not reaching tip of tegmina, the extre
vein curving only upward; externomedian are
large.
g^1. Externomedian and internomedian veins sinuous, dis
around a median stigma ....
g^2. Externomedian and internomedian veins nearly str
or no median repulsion ....
d^2. Mediastinal area long, usually at least three-fourths th
tegmina, sometimes nearly reaching the tip.
e^1. Branches of scapular vein superior.
f^1. Externomedian branches superior, so that the nervul
either side of the externomedian-internomedian i

f^2. Externomedian branches inferior, so that the nervul
either side of the scapular-externomedian intersp
11.
e^2. Branches of scapular vein inferior .... 12.
c^2. Internomedian vein short, terminating before the middle c
of the tegmina; scapular and externomedian are
erally covering more than half the tegmina.
d^1. Branches of externomedian vein inferior.
e^1. Principal veins closely crowded in the basal half of the teg
uniformly distributed all over the wing; scapula
ing above the apex of the tegmina .... 13.

Table of the genera of American fossil cockroaches—Continued.

Principal veins widely separated in the basal half of the tegmina; branches much more closely crowded in some parts of the tegmina than in others; scapular area terminating below the apex of the tegmina.................................... 14. *Oryctoblattina.*
ome or all of the branches of externomedian vein superior.
Externomedian vein directed toward the distal half of inner border of tegmina; internomedian vein moderately long.. 15. *Poroblattina.*
Externomedian vein directed toward and terminating at or but little beyond the middle of the inner border of tegmina; internomedian vein very short................................ 16. *Petrablattina.*
more of the six principal veins of tegmina amalgamated through the whole or the greater part of their length; most of the anal veins impinging on the anal furrow or forming a fusiform bunch directed toward the tip of the furrow....... NEOBLATTARIÆ.
ce of tegmina distinctly divided into four fields, each occupied by a principal vein (Mesozoic genera).
nina diaphanous, rounded at tip, not strongly vaulted; anterior main vein sinuous, falling short of apex.......... 17. *Neorthroblattina.*
nina coriaceous, more or less pointed at tip, strongly vaulted at base; anterior main vein straight, terminating at or below the apex. 18. *Scutinoblattina.*
e of tegmina not distinctly divided into four fields, but either into three or the neuration greatly confused by adventitious folds (Cenozoic genera).
wings without a longitudinal fold; neuration normal.
ernomedian branches mostly arising from a dichotomous division of two main stems .... 19. *Zetobora.*
ternomedian branches mostly arising as simple inferior branches of two main stems .... 20. *Homoeogamia.*
wings with a longitudinal fold, interfering with the neuration. 21. *Paralatindia.*

PALÆOBLATTARIÆ.

ogical range of this ancient type of cockroaches was formerly
o be limited to Paleozoic time and specifically to Carbonifer-
ermian rocks; but it has since been shown that it occurs in
bers in the Trias of Colorado, which now forms its upper
riorly it has been found scantily in the Millstone Grit, but
be little doubt that its actual appearance on the earth was
earlier epoch.[1]

h our knowledge has been vastly extended within the past
rs and the number of known species has been multiplied
fold, principally from additions in this country, the number
has increased by only about two-thirds, and the number of
oups remains the same. We are now acquainted with six-
a and about two hundred species, by far the larger part of
ng to one of the two principal divisions, the Blattinariæ.

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a *douvillei* Brongn., from the lower part of the Upper Silurian of Jurques, Calvados,
d by Brongniart as a cockroach, appears to me from his figures to belong to the neu-
, and therefore it is not considered here.

MYLACRIDÆ.

This group of Palæoblattariæ, with a single exceptic *harei*), found in the Barren Coal-measures, is confined t ductive Coal-measures, and, as far as definitely know deposits. Brongniart, as pointed out above (p. 21), st cridæ are common in the Coal-measures of Commentry, there is no reason to doubt his statement, but the pro yet been published. Considering that they are unknow later rocks, and seem to represent an older type than th it is a little surprising that they have not as yet, like se Blattinariæ, been detected in the Millstone Grit. Their range is therefore considerably more confined than tha nariæ, which extend from the Millstone Grit to the Tria and twenty-nine species have so far been detected, with others. By far the majority occur in the older true P measures, and below the Barren Coal-measures they are dant in species as the Blattinariæ, though representing f

1. Genus MYLACRIS.

Mylacris Scudd., Worth., Geol. Surv. Ill., III, 568–569.

This genus is confined, so far as known, to North Ame richest of the Mylacridæ in species, fourteen in number fact nearly as rich as all the other genera of Mylacridæ has been found in four different coal basins—the Acad Island, the Pennsylvania, and the Eastern Interior, in which it is richest in species. As far as known, it is mo the Lowest Productive Coal-measures, though one of the the anthracite fields of Pennsylvania (near the base o *M. carbonum*, is common to them and the Lower P measures, and affords almost the only instance whe Carboniferous species has been found, even in two separ

Table of the species of Mylacris.

a^1. Mediastinal area slender, especially at base.
  b^1. Scapular nervules longitudinal, very long, and not numerous.
  b^2. Scapular nervules oblique, numerous, and not very long....
a^2. Mediastinal area broad, especially at base.
  b^1. Externomedian nervules superior or apical.
    c^1. Externomedian nervules distinctly superior.
      d^1. Costal margin considerably arcuate on the basal third o that the humeral shoulder is well rounded.
        e^1. Tegmina almost or quite two and a half times longer t
        e^2. Tegmina hardly if any more than twice as long as broa
          f^1. Mediastinal area reaching only to the end of the middl mina; internomedian vein with numerous closely c 4.

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[1] See my Paleozoic Cockroaches. Mem. Bost. Soc. Nat. Hist., III, 31, 32; Foss. I

Table of the species of Mylacris—Continued.

f^2. Mediastinal area reaching well into the distal third of the tegmina; internomedian vein with few and rather distant branches. 5. *M. gurleyi.*

d^2. Costal margin very slightly arcuate on the basal third of the tegmina, so that the humeral shoulder is very pronounced.

e^1. Scapular area much less important than the externomedian, the tegmina rapidly narrowing in the apical half.................. 6. *M. ampla.*

e^2. Scapular area much more important than the externomedian, the tegmina much less rapidly narrowing apically.... 7. *M. priscovolans.*

c^2. Externomedian nervules rather apical than superior.

d^1. Externomedian area occupying the apex of the tegmina..... 8. *M. heeri.*

d^2. Externomedian area falling wholly below the middle line of the tegmina.

e^1. Mediastinal nervules comparatively few and distant; scapular vein forked at base.................................... 9. *M. antiqua.*

e^2. Mediastinal nervules numerous; scapular branches all emitted from a single main branch.............................. 10. *M. lucifuga.*

b^1. Externomedian nervules inferior.

c^1. Costal much more curved than inner margin.

d^1. Costal margin very strongly curved in the mediastinal area, which scarcely reaches to the middle of the tegmina..............11. *M. carbonum.*

d^2. Costal margin gently curved in the mediastinal area, which extends considerably beyond the middle of the tegmina.. 12. *M. pennsylvanica.*

c^2. Costal and inner margins similarly and symmetrically curved.

d^1. Combined mediastinal and scapular areas as broad at the base as beyond. 13. *M. mansfieldii.*

d^2. Combined mediastinal and scapular areas much broader near the middle of the tegmina than at the base.................. 14. *M. ovalis.*

1. MYLACRIS PACKARDII.

Pl. I, figs. 2, 3.

Mylacris packardii Scudd., Bull. U. S. Geol. Surv. No. 101, pp. 11–12, pl. 1, figs. *e. g.* (1893).

From the Lowest (?) Productive Coal-measures at Bristol, R. I.

2. MYLACRIS BRETONENSIS.

Blattina bretonensis Scudd., Can. Nat., VII, 271–272, fig. 1 (1874).

Mylacris bretonensis Scudd., Mem. Bost. Soc. Nat. Hist., III, 41–42, 300, pl. 5, fig. 1 (1879); Foss. Ins. N. A., I, 61–62, 264, pl. 5, fig. 1 (1890).

From the Productive Coal-measures of Sydney, Cape Breton.

3. MYLACRIS ELONGATA sp. nov.

Pl. I, fig. 6.

The tegmina are unusually slender for a Mylacris, the specimen at hand, though incomplete at both extremities, being certainly two and a half times longer than broad; it is subequal in width on the basal half, but on the apical half narrows somewhat rapidly by the stronger arcuation of the costal margin, the inner margin being almost straight except at the extreme base and perhaps the tip; the extreme apex is broken. The veins originate below the middle of the somewhat strongly upward before assuming their final for most of them is subparallel to the outer margin o toward the tip. The mediastinal area is rather narrow and more than usually elongated, tapering more gradu and reaching almost or quite to the end of the midd wing; most of the nervules are simple throughout. Th vein begins to branch by or before the middle of the b wing, and while branching is almost exactly straight to the outer margin, coursing through the middle of the before emitting its last branch it is gently arcuate and a parallel to the inner margin; it sends off six branches mediastinal branches, all simple except one, which forked. The externomedian vein runs parallel to the s branches just before the middle of the wing, and then downward and terminates on the inner margin, th principal nervules, the first of which is doubly forked median vein is gently sinuate and parallel to the throughout its course, terminating on the inner margi the tip; its branches are mostly simple, but may be do are strongly oblique and arcuate, with their convexities of the anal furrow. Anal area reaching nearly to th wing, strongly tumid; the anal furrow strongly arcu straight in its apical third; the anal veins consist of tw pying almost the entire half of that portion lying ne row, consisting of a main vein with two branches, one all with a gentle arcuation in the same sense as the a other consisting of a crowd[1] of parallel, strongly obliqu simply forked veins gently oblique in a sense opposite anal furrow, and occupying the inner basal half.

Length of fragment, 34 mm.; probable length of te width, 15 mm.

This clearly marked species resembles most closely from the same beds. The general relation of all the is almost precisely the same, but it is distinctly separ species by its form, which is much more slender tha *cophila* and thus gives to the mediastinal area in pa different form.

A single specimen and its reverse were found in t ductive Coal-measures at Mazon Creek by Mr. J. C. Ca in the collection of Mr. R. D. Lacoe, of Pittston, Pa., collection the number 2014 *a–b*.

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[1] Only a few of them have been represented by the artist; they occupy t portion of the area.

4. MYLACRIS ANTHRACOPHILA.

Pl. 1, figs. 1, 4.

hracophila Scudd., Worth., Geol. Surv. Ill., III, 568–570, figs. 5, 6 (1868); st. Soc. Nat. Hist., III, 45–47, pl. 5, figs. 6–8 (1879); Foss. Ins. N. A., 271, pl. 5, figs. 6–8 (1890).

Lowest Productive Coal-measures at Colchester, Ill.

5. MYLACRIS GURLEYI sp. nov.

Pl. I, fig. 5.

le specimen preserved in a nodule represents two tegmina ion of one of the under wings in a nearly natural position, nbracing a solid substance next the under surface, so as to rongly convex appearance, the cross section forming indeed ctly a semicircle, as seen in the line above indicating it. he tegmina is preserved entire, the tip of both, but no great ng lost, showing that the form of the tegmina was subtri- ry broad at base but tapering rapidly and equably beyond ently narrowly rounded apex, the form thus not differing in al respect from that of *M. anthracophila.* The whole wing nore than twice as long as broad. The mediastinal area e two wings, in the right terminating just at the end of the about the middle of the apical fourth of the wing, but in g at the beginning of the apical fourth; the area is filled number of simple or forked, usually apically forked, more ate, slightly diverging branches, subequidistant throughout rea. The scapular vein runs nearly parallel to the costal is much straighter than it, and terminates on the right at apex of the wing, on the left wing at a slight distance the right wing it does not branch until beyond the apical fact has but a single branch, which is deeply forked, the running in an almost straight longitudinal course to the of the wing; in the left wing, however, it has four simple eeply forked branches, the vein beginning to branch near base of the wing, and the branches thrown off at equal ong the vein; on the right wing, therefore, the interspace scapular and the externomedian vein runs almost exactly middle of the wing; it does so also on the left wing through lf of the same, but thereafter curves very slightly upward minate, as before remarked, above the tip. The externo- is similarly different in the two wings; on the right wing cuate course and terminates on the inner margin at a con- stance short of the end of the mediastinal area, and emits raight, longitudinal branches, the first beyond the middle ; on the left wing it is much straighter and terminates on the inner margin a long distance beyond the apex of the mediastinal area, and has but two branches, the first of which, arising but shortly beyond the basal third of the wing, is compound, while the second arises at the beginning of the apical third of the wing, the area occupying the apex of the wing, more, however, upon its inner than its costal side. The internomedian vein runs exactly parallel to the externomedian and is therefore more curved on the right than on the left wing, and has three or four simple or deeply-forked branches which arise at equal distances on the left wing but at very unequal distances on the right. The anal furrow is deeply impressed, but its apical portion is lost in both wings; it appears, however, to terminate beyond the basal third of the wing and to be strongly arcuate at the base, beyond nearly straight; the anal area is filled with a number of mostly simple branches, but on the right wing many of them originate at equal distances apart from the vein which runs subparallel and next to the anal furrow, while on the left wing it is one of the middle veins which is compound.

A broken portion of one of the hind wings is preserved, that of the right side, which seems to show that the externomedian and internomedian veins were somewhat similar to those of the fore wing, but that they had a straight, longitudinal course instead of being strongly arcurate, as in the fore wing, and the internomedian branches arise at equal distances apart.

This insect appears at first sight to show a greater difference between the neuration of the two fore wings than any other species which has yet been described, but in reality the difference is almost entirely made up by the greater extent of the mediastinal area on the right wing and the consequent pushing of all the succeeding areas farther along to the final reduction of the internomedian area. It, and especially the left wing, resembles very closely *M. anthracophila* from the same region, but differs from it markedly in the much slighter importance of the externomedian vein, although the space occupied upon the margin by this area is scarcely less. Nevertheless, on account of the difference in venation of the two wings, I had a brief hesitation to recognize it as distinct from *M. anthracophila*, but until further remains are obtained it seems wiser so to regard it. Indeed, the range of variation in the species of ancient cockroaches is a question which, even with our present greatly extended knowledge of them, it is difficult to decide, and we must still await a larger amount of material before we can come to any safe conclusion.

Length of longest fragment of tegmina, 25 mm.; probable length of tegmina, 27 mm.; breadth, 13 mm.

A single specimen from the Lowest Productive Coal-measures at Mazon Creek, Illinois, showing obverse and reverse, was obtained by W. F. E. Gurley.

6. MYLACRIS AMPLA sp. nov.

Pl. II, fig. 1.

Two well-preserved tegmina lying nearly in place, but a little separated from each other by crushing, represent this species, besides which a few segments of the abdomen are perceptible. The tegmina are unusually broad and are pretty well preserved, only the apical portion of one and the apical outer marginal portion of the other being lost at the edge of the stone. The humeral shoulder is particularly well marked, almost exactly rectangulate, with the extreme angle rounded, while the outer margin, at least in its basal half, is gently emarginate and slightly recurved. The wing is somewhat less than twice as long as broad, with the inner margin apparently nearly straight, perhaps very gently convex; the outer margin gently convex in the basal half, rather strongly convex on the apical half, so that the wing narrows rapidly behind; the form of the tip, however, can not be determined. The main veins originate at about the middle of the base of the wing, and are gently arcuate or sinuate throughout most of their course. The relative importance of the different areas appears to vary distinctly in the two wings, and the mediastinal area is of grand importance, partly on account of its great lateral expanse at the base, partly from its long extension along the outer margin, for, on the complete right wing, where it appears to be more highly developed, it extends to beyond the middle of the apical half of the outer margin and is filled with radiating veins, many of them forked and apparently formed mainly of two clusters, an outer and basal, in which the forks originate near the middle of their course, and an inner, where they are variable. The mediastinal vein takes a sinuate course, and with the externomedian appears to be more variable than any of the others; together they occupy the apex of the wing, and apparently, to judge from one wing, may unite near the middle of the basal half of the wing and form one basal stem, or they may be entirely independent, one of the other, as in the opposite wing. In the former case, as is seen in the right wing in the drawing on the plate, the scapular vein is of small importance, having but three branches, one of them once forked near the tip and terminating somewhat before the tip of the wing, while the externomedian vein occupies the entire tip of the wing, terminating on the inner border opposite the extremity of the mediastinal area and filling the space with three or four compound or forked branches. On the left wing, however, the scapular vein is of decidedly greater importance, having at least four branches, the first of them compound, and it must terminate much nearer the apex of the wing (here broken) than can be the case upon the opposite side; while the externomedian, entirely independent from its very origin, divides into two branches at no great distance before the middle of the wing, each of which branches, and especially the lower, is compound; having a general effect similar to that of the same vein on the opposite wing, but with more crowded neuration. The internomedian vein is obscure upon the right wing but clearly marked upon the left; its termination, however, is plainly similar in both; on the left wing it is seen to have four principal branches, of which the second, at least, is forked, while the other appears to be simple; its course is gently sinuate, having beyond its arcuation in the basal half a distinctly more longitudinal trend. The anal furrow is rather strongly and pretty uniformly arcuate and terminates very shortly before the middle of the wing; the anal area, which is rather strongly vaulted, is filled with a series of eight or ten veins, gently arcuate in the same sense as the furrow and either simple or united to one another close to their base. Little more can be said of the abdominal segments than that they are rather short and broad and appear to be perfectly smooth, showing no structure whatever.

Length of the longest fragment of the tegmina, 30 mm.; probable length of tegmina, 33 mm.; breadth, 17 to 18 mm.; breadth of the two tegmina as they lie upon the stone, 35 mm.; length of abdominal segments, 2 mm.

This species is more nearly related to *M. priscovolans* than to any other, but is remarkable for its extreme breadth, being much broader in proportion to its length than even in that species, but showing a somewhat similar length of the mediastinal area and distribution of the branches of the nervules therein. It differs in the much earlier origin of the branching of the externomedian vein and in general resembles *M. priscovolans* more by its left wing than by its right. The branch of the anal area is very different, as also the form of the wing.

The single specimen and its reverse, remarkably well preserved as to texture and of a fusco-castaneous color, are embedded in a nodule from the Lowest Productive Coal-measures, at Mazon Creek, Illinois, in the collection of Mr. R. D. Lacoe, where they bear the number 2021 *a–b*.

7. MYLACRIS PRISCOVOLANS.

Mylacris priscovolans Scudd., Mem. Bost. Soc. Nat. Hist., III, 307–308, pl. 27, fig. 9 (1884); Foss. Ins. N. A., I, 271–272, pl. 13, fig. 9 (1890).

From the bituminous coal shale of the Lowest Productive Coal-measures of Cannelton, Pa.

8. MYLACRIS HEERI.

Blattina heeri Scudd., Can Nat., VII, 272, fig. 2 (1874).
Mylacris heeri Scudd., Mem. Bost. Soc. Nat. Hist., III, 43–44, pl. 5, fig. 11 (1879); Foss. Ins. N. A., I, 63–64, 264, pl. 5, fig. 11 (1890).

Productive Coal-measures of Sydney, Cape Breton.

9. MYLACRIS ANTIQUA.

Pl. II, figs. 5, 6.

Mylacris antiqua Scudd., Mem. Bost. Soc. Nat. Hist., III, 300–301 (1884); Foss. Ins. N. A., I, 264–265 (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinois.

10. MYLACRIS LUCIFUGA.

ifuga Scudd., Mem. Bost. Soc. Nat. Hist., III, 301–302, pl. 27, fig. 8 (1884);
s. N. A., I, 265–266, pl. 13, fig. 8 (1890).

e roof shales of the E seam of coal at the Port Griffith
k, near Pittston, Pa.

11. MYLACRIS CARBONUM.

bonum Scudd., Mem. Bost. Soc. Nat. Hist., III, 304–307, pl. 27, figs. 6, 7,
); Foss. Ins. N. A., I, 268–271, pl. 13, figs. 6, 7, 10 (1890).

the only species of Paleozoic cockroach (with the possible
of *Etoblattina balteata*) yet found in America at two distinct
ne of them being in the bituminous coal shale of the Lowest
Coal-measures of Pennsylvania, at Cannelton, the other in
series at the horizon of the E vein in the Empire mine at
re, in the same State. Some differences appear in the speci-
the two localities, and it is possible that when complete
are found it may be necessary to separate the older and
rms.

12. MYLACRIS PENNSYLVANICA.

sylvanica Scudd., Mem. Bost. Soc. Nat. Hist., III, 44–45, pl. 5, figs. 13,
; ibid., III, 302-304, pl. 27, fig. 11 (1884); Foss. Ins. N. A., I, 64–65,
l. 5, figs. 13, 14, pl. 13, fig. 11 (1890).

e bituminous coal shales of the Lowest Productive Coal-
t Cannelton, Pa.

13. MYLACRIS MANSFIELDI.

sfieldi Scudd., Mem. Bost. Soc. Nat. Hist., III, 47, pl. 5, fig. 15 (1879);
377–378 (1890); Foss. Ins. N. A., I, 67, 272, 401–402, pl. 5, fig. 15 (1890).

same as the preceding.

14. MYLACRIS OVALIS.

s Scudd., Mem. Bost. Soc. Nat. Hist., III, 308-309, pl. 27, fig. 5 (1884);
N. A., I, 272–273, pl. 13, fig. 5 (1890).

same as the last two.

2. Genus PROMYLACRIS.

udd., Proc. Acad. Nat. Sc. Philad., 1885, 34 (1885).

s, of which four species are known, has apparently a wider
any of the other genera of Mylacridæ, having been found
the Lowest Productive Coal-measures in the Eastern Inte-
here three species occur, but also, in a single instance, in
Coal-measures of the Western Interior basin.

Table of the species of Promylacris.

a^1. Prothorax distinctly twice as broad as long. Scapular vein much more important than the externomedian.
  b^1. Most of the scapular branches arising at regular intervals from the main stem. 1. *P. harei.*
  b^2. About half the scapular branches clustered as offshoots of its basal branch. 2. *P. testudo.*

a^2. Prothorax distinctly less than twice as broad as long. Scapular vein not more important than the externomedian.
  b^1. Prothorax more than half as broad again as long. Scapular vein far less important than the externomedian; anal veins simple............ 3. *P. ovalis.*
  b^2. Prothorax less than half as broad again as long. Scapular vein not far less important than the externomedian; anal veins mostly forked..... 4. *P. rigida.*

1. PROMYLACRIS HAREI sp. nov.

Pl. II, fig. 3.

A single fore wing from which the anal area is lost and in which the details of the internomedian area are also lost; it is of a regular oval form, except for the straightness of the inner margin, the costal margin being strongly arcuate throughout and the tip broadly rounded; the whole wing is slightly more than twice as long as broad. The mediastinal area terminates at the middle of the costal margin and is filled at least in its outer two-thirds with radiating, straight, forked, rather closely crowded branches, of which some eight or ten reach the margin at equal distances apart. The scapular vein is strongly sinuous and in the basal half of the wing subparallel to the costal margin, terminating just above the extreme apex of the wing; it has half a dozen subequidistant branches, most of them deeply, sometimes doubly forked, the first arising far toward the base and not diverging from the main stem for some distance and then separating into three branches, the outermost apically forked; these branches are nearly straight, less crowded than those of the mediastinal area, oblique, the apical ones longitudinal. The externomedian vein runs parallel to the scapular and does not branch until beyond the middle of the wing, when it throws off three longitudinal branches to the outer margin, the uppermost deeply forked. The course of the internomedian vein and its branches can not certainly be determined, but it terminates shortly before the apex of the wing and has on the margin numerous oblique branches, apparently similar in all respects to those of the scapular area. The anal furrow is slightly impressed, in its apical portion nearly straight, and terminates exactly at the middle of the wing.

In the form of the wing, which is less tapering than usual, this species seems to be most nearly allied to *P. testudo*, but differs considerably from it in the character of its scapular branches.

Length, 17.5 mm.; breadth, 8.5 mm.

This interesting specimen, the only species of Mylacridæ known from above the Productive Coal-measures, was found by Mr. Sidney J. Hare, a most enthusiastic searcher and student in natural history, about 170 feet above the base of the Upper Barren Coal-measures at Kansas City, Mo., and is named after him at the suggestion of Mr. R. D. Lacoe, in whose collection it bears the number 2087*a*.

2. PROMYLACRIS TESTUDO.

Pl. II, fig. 2.

Promylacris testudo Scudd., Mem. Bost. Soc. Nat. Hist., IV, 403, pl. 32, fig. 6 (1890); Foss. Ins. N. A., I, 379, pl. 24, fig. 6 (1890).

Through the kindness of Mr. R. D. Lacoe, I have had the opportunity of examining a second specimen of this species. It is somewhat smaller than the first, but has the same vaulted form, and in each case the figure represents the convex surface and not the concave cast. The first thing that will be noticed is that there is a similar difference in the venation of the opposite tegmina, only that the difference is reversed, the simpler form of branching of the scapular vein being seen on the left side in one specimen, on the right side in the other. The drawing of the mediastinal vein of the left wing in the present specimen is slightly incorrect in that the forking of the branches has been overlooked, it differing but little from that of the opposite wing. The costal margin is scarcely so convex as in the type; the mediastinal area is a little longer, terminating a little beyond the tip of the anal furrow. On each wing the branches of the scapular vein are divided into two sets just beyond the middle of the basal half of the wing, but on the left side, from the less numerous branches, the vein is less complicated than on the right, where the outer of the two at once forks into two sets of three or four branches each, and the inner divides farther out in very regular fashion into two ultimately forked branches, giving in all eleven veinlets to the margin; on the left side the outer divides into three superior branches, the inner, at first into two, the outer of which is simple, the inner of which sends from before its middle a forked superior branch, in all only seven veinlets at the margin. In the type, on the more complicated left side, by the apical forking of nearly all the branches, no less than eighteen veinlets are found upon the margin; the right side, being broken at the margin, the number of apical veinlets can not be determined, but it is probably from ten to thirteen. The externomedian vein differs from the type mainly in its later initial forking, which is decidedly beyond that of the scapular vein and but little before the tip of the anal furrow. The internomedian area is larger on the left than on the right wing, but does not differ essentially from the same area in the type. The anal furrow is entirely similar to that of the type (which is wrongly stated in the original description to terminate "a little beyond," instead of a little before, the middle of the wing), and as there the anal area is strongly vaulted, but its veins are less numerous, and one at least is deeply forked.

Length of the fragment, 13 mm.; probable length of tegmina, 15 mm.; breadth of closed tegmina, 12.5 mm.

The specimen is numbered in Mr. Lacoe's collection 2089*a*, and, like the original, comes from the Lowest Productive Coal-measures at Mazon Creek, Illinois.

3. PROMYLACRIS OVALIS.

Promylacris ovalis Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 34-35 (1885); Mem. Bost. Soc. Nat. Hist., IV, 403, 404, pl. 31, figs. 1-4 (1890); Foss. Ins. N. A., I, 379, 380, pl. 23, figs. 1-4 (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinois.

4. PROMYLACRIS RIGIDA.

Pl. III, fig. 1.

Promylacris rigida Scudd., Mem. Bost. Soc. Nat. Hist., IV, 403, 404-405, pl. 31, fig. 6 (1890); Foss. Ins. N. A., I, 379, 380-381, pl. 23, fig. 6 (1890).

From the Lowest Productive Coal-measures at Braidwood, Ill.

3. Genus LITHOMYLACRIS.

Lithomylacris Scudd., Mem. Bost. Soc. Nat. Hist., III, 48 (1879); Foss. Ins. N. A., I, 68, (1890).

This is the only genus of Mylacridæ which has been found more abundantly in the Younger than in the Older Productive Coal-measures, three out of the four species being confined to them in the Pennsylvania rocks, while the remaining species is found low down in the Older Productive Coal-measures in the Eastern Interior basin at Mazon Creek, Illinois.

Table of the species of Lithomylacris.

a^1. Externomedian vein first forking at or before the middle of the tegmina.
  b^1. Tegmina slender, fully three times as long as broad.
    c^1. Nervules numerous and very crowded; scapular branches often forked. 1. *L. angusta.*
    c^2. Nervules less numerous and neuration more open; scapular branches always simple.. 2. *L. pittstoniana.*
  b^2. Tegmina relatively stout, being but little more than twice as broad as long. 3. *L. pauperata.*
a^2. Externomedian vein first forking well beyond the middle of the tegmina. 4. *L. simplex.*

1. LITHOMYLACRIS ANGUSTA.

Lithomylacris angusta Scudd., Mem. Bost. Soc. Nat. Hist., III, 48-50, pl. 5, figs. 2, 3 (1879); Foss. Ins. N. A., I, 68-70, pl. 5, figs. 2, 3 (1890).

From the roof shales of the E seam of coal at the Port Griffith switchback, near Pittston, Pa.

2. LITHOMYLACRIS PITTSTONIANA.

Lithomylacris pittstoniana Scudd., Mem. Bost. Soc. Nat. Hist., III, 50-51, pl. 5, figs. 4, 10 (1879); Foss. Ins. N. A., I, 70-71, pl. 5, figs. 4, 10 (1890).

From the same locality and horizon as the preceding.

3. LITHOMYLACRIS PAUPERATA.

Lithomylacris pauperata Scudd., Mem. Bost. Soc. Nat. Hist., IV, 409–410, pl. 32, fig. 5 (1890); Foss. Ins. N. A., I, 385–386, pl. 24, fig. 5 (1890).

From the same locality and horizon as the last two.

4. LITHOMYLACRIS SIMPLEX.

Lithomylacris simplex Scudd., Mem. Bost. Soc. Nat. Hist., III, 51–52, pl. 5, fig. 5 (1879); Foss. Ins. N. A., I, 71–72, pl. 5, fig. 5 (1890).

From the Lowest Productive Coal-measures at Danville, Ill.

4. Genus PAROMYLACRIS.

Paromylacris Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 35 (1885).

This genus, containing five known species, is confined to the Productive Coal-measures and almost entirely to its lowest members, only one species occurring near Pittston, Pa., near the base of the upper of the two divisions into which I have tentatively divided the Productive Coal-measures. One of the others occurs in the Western Interior coal basin, within 50 feet of the base of the true Coal-measures, the others in the Eastern Interior basin in the Mazon Creek beds, Illinois.

Table of the species of Paromylacris.

a^1. Tegmina broadly and pretty regularly obovate, the apical not much less than the basal breadth.
  b^1. Prothorax much more than twice as broad as long; anal furrow terminating at or before the middle of the tegmina............................ 1. *P. rotunda.*
  b^2. Prothorax much less than twice as broad as long; anal furrow terminating well beyond the middle of the tegmina............................ 2. *P. ampla.*
a^2. Tegmina tapering strongly, the apical much less than the basal breadth.
  b^1. Mediastinal area reaching well beyond the middle of the tegmina; externomedian veins very strongly arcuate .... 3. *P. triangularis.*
  b^2. Mediastinal area not reaching the middle of the tegmina; externomedian veins very gently arcuate.................................... 4. *P. clintoniana.*

P. pluteus is not included in this table.

1. PAROMYLACRIS ROTUNDA.

Paromylacris rotunda Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 35 (1885); Mem. Bost. Soc. Nat. Hist., IV, 406–408, pl. 32, figs. 1, 2 (1890); Foss. Ins. N. A., I, 382–384, pl. 24, figs. 1, 2 (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinois.

2. PAROMYLACRIS AMPLA.

Pl. III, fig. 4.

Paromylacris ampla Scudd., Mem. Bost. Soc. Nat. Hist., IV, 408, pl. 31, fig. 7 (1890); Foss. Ins. N. A., I, 384, pl. 23, fig. 7 (1890).

From the Lowest Productive Coal-measures at Braidwood, Ill.

3. PAROMYLACRIS TRIANGULARIS sp. nov.

Pl. III, fig. 3.

Represented by a somewhat confused mass of wings. out of which one of the tegmina can be easily distinguished throughout the most of its extent, the tip only broken; this has a remarkably triangular form, the front margin strongly arcuate at the base but beyond straight, the inner margin independently arcuate on the anal area and beyond, the whole wing tapering rapidly and regularly beyond the tip of the anal furrow. The whole wing is a little more than twice as long as its extreme breadth next the base. The mediastinal area is of great extent, terminating about the middle of the distal halt of the wing, very broad at the base and gradually tapering, the branches of the vein mostly forked, sometimes doubly forked, and several of them originating beyond the base of the wing, as is the case with other species of Paromylacris, in which respect this genus approaches Necymylacris; the branches are strongly oblique and not very closely crowded; the mediastinal vein is very strongly sinuous, first forks immediately after its separation from the internomedian vein, with which it is united in the basal fifth of the wing, each of its forks again almost immediately subdivided, and their lowermost branches, very deeply forked, send at last about half a dozen nervules to the upper margin, the lowermost striking the tip of the wing; all these branches are but gently sinuous in the apical half of the wing and directed longitudinally upward; the externomedian vein is very similar to the scapular, forking immediately on its freedom from the scapular, each of its branches again forking in the middle of the wing, all having a strongly sinuous course, and after their final forking nearly longitudinal. The internomedian vein is likewise broadly sinuous, and terminates on the inner margin somewhat beyond a point opposite the tip of the mediastinal vein, the main branch having a sinuous course parallel to the lower branches of the externomedian vein; it has three or four simple or forked branches, separating fan-like upon the anal border. The anal furrow is very deeply impressed, very strongly sinuous, and terminates on the inner margin considerably before the middle of the wing; the only veins which can be seen in the anal area are those on the half which is removed from the anal furrow, and they are here straight and parallel.

Length of fragment, 17 mm.; probable length of tegmina, 21.5 mm.; breadth, 10 mm.

A single specimen and its reverse come from the nodules of Mazon Creek, Illinois, and are in the collection of Mr. R. D. Lacoe, bearing the number 2110 *a*, *b*. They come from the Lowest Productive Coal-measures.

4. PAROMYLACRIS CLINTONIANA sp. nov.

Pl. III, fig. 6.

A single well-preserved fore wing with the extreme base and apex destroyed. The form of the tegmina is not so distinctly triangular as in the preceding species, but it tapers with great regularity from the same point, mostly through the arcuation of the inner margin, the front margin being very gently arcuate, so that the tip must fall above the middle, which is very unusual. The mediastinal area is rather short, scarcely extending so far as the anal furrow; very broad at base, it rapidly narrows, and is filled with but few branches, most of which are forked close to the margin, and, as in the species of Paromylacris in general, one at least of the principal branches originates far beyond the base of the tegmina. The scapular vein is the most important in the tegmina. occupying with its branches a very considerable portion of its area. It is made up of two clusters which part at no great distance from the base of the tegmina, the uppermost bearing three long branches, part of which are forked next the margin, following the general course of the branches of the mediastinal area. The lower cluster subdivides into two sets at about the end of the basal third of the tegmina—the upper composed of three, the lower of four, long, gently arcuate, upturned, simple branches, which cover the remainder of the front margin as far as the tip of the tegmina; as a whole, the main scapular vein, or rather the main vein of the lower cluster, has a gently sinuous course through the middle of the tegmina, falling below it in its middle portion. The externomedian vein is formed of two slightly compound branches originating from a main stem, which first subdivides a little beyond the first forking of the lower cluster of the scapular vein. Its branches are very gently sinuous, nearly longitudinal, and terminate on the outer and inner borders of the tegmina. The internomedian vein is very gently sinuous, running in a nearly straight course after its basal arcuation to the middle of the apical half of the tegmina, and has five simple, in one case rather deeply forked, straight and oblique branches. The anal furrow is deeply impressed, sharp, and gently arcuate, and, what is most extraordinary, forks just before the tip, and terminates at about the middle of the tegmina. The anal veins are longitudinally oblique, deeply forked, straight or arcuate, rather distant, and subparallel to the basal half of the anal furrow.

This species is remarkable for the slenderness of the tegmina and the curious manner in which they taper by the stronger arcuation of the inner than of the front margin; it is more nearly allied to the preceding species than to any other, but departs widely from it in these respects.

Length of fragment, 15 mm.; probable length of tegmina, 21 mm.; breadth, 8 mm.

Obtained from a coal bank near Clinton, Mo., belonging to the Very Lowest Productive Coal-measures, found within 50 feet of their extreme base; it is in the collection of Mr. R. D. Lacoe, under the number 2151*a*.

5. PAROMYLACRIS? PLUTEUS sp. nov.

Pl. III, fig. 2.

A basal fragment of a fore wing appears to belong to a distinct species of Paromylacris, but is referred here doubtfully, as its reference depends largely upon the form of the wing, the larger part of the margin of which is conjectural. That it is one of the Mylacridæ is evident from the character of the preserved part of the mediastinal area. The direction of the inner margin beyond the anal area, with the direction and tendencies of the mediastinal and scapular veins, indicate that these two veins occupy at least one-half of the tegmina; while, if this were the case, the wing could hardly have had the slender form of Lithomylacris, as apparently also it had not the apically confined area of the externomedian vein. These points would indicate that it fell in Paromylacris, though it is not impossible that it is a Necymylacris, its next neighbor. In either case the structure of the anal area is different from anything known in this vicinity, and indicates a species hitherto unknown and of considerable size.

Assuming the margin to be correctly delineated, the mediastinal area probably extended to some distance beyond the middle of the tegmina, and the scapular area occupied the rest of the upper half of the tegmina, the main vein of the latter beginning to branch just beyond the basal fifth of the tegmina, where it is bent in its course. The externomedian vein runs parallel to the scapular, first branches before the middle of the tegmina, and apparently occupies on the margin almost half as much space as the scapular. The internomedian vein, of which more can be seen, runs in a very gently arcuate course and terminates far toward the tip of the tegmina, with three or four very inequidistant, deeply forked or simple, nearly straight or slightly arcuate, strongly oblique branches. The anal furrow terminates beyond the middle of the tegmina, and besides being strongly bent next the base is again gently bent beyond the middle of the remainder, being otherwise nearly straight; and by the fullness of this portion of the inner margin which has an independent curve, the whole area is subequal in breadth to near its rapidly tapering extremity; it is filled, at least away from the anal furrow, with numerous simple or deeply forked veins parallel to its sides, but arcuate apically. The whole area is fully three times as long as broad.

The species appears to fall in the near vicinity of *P. ampla*, but is smaller than it, and apparently has a larger development of the internomedian area and an earlier branching of the externomedian vein.

ı of fragment, 21.5 mm.; probable length of tegmina, 30 mm.; breadth, 16 mm.

le specimen found in the Butter mine at Pittston, Pa., in the r the E coal or Pittston coal by Mr. R. D. Lacoe, in whose it bears the number 2040*a*.

5. Genus NECYMYLACRIS.

s Scudd., Mem Bost. Soc. Nat. Hist., III, 52–53 (1879); Foss. Ins. N. A., I, 1890).

o known species of this genus both occur in the Pennsylvania , in the Lowest Productive Coal-measures. No species have d to the genus since its first description fourteen years ago.

Table of the species of Necymylacris.

vein short; internomedian vein arcuate throughout..... 1. *N. lacoana.*
vein long; internomedian vein straight through most of its course but ate.. 2. *N. heros.*

1. NECYMYLACRIS LACOANA.

s *lacoana* Scudd., Mem. Bost. Soc. Nat. Hist., III, 53–54, pl. 5, fig 12 (1879); s. N. A., I, 73–74, pl. 5, fig. 12 (1890).

e Boston mine, near Pittston, Pa., in the Lowest Productive ures.

2. NECYMYLACRIS HEROS.

heros Scudd., Mem. Bost. Soc. Nat. Hist., III, 54–56, pl. 5, fig. 9 (1879); s. N. A., I, 74–76, pl. 5, fig. 9 (1890).

e roof shales of coal C in the Boston mine near Pittston, Pa., wer Productive Coal-measures. By error in the original ı it was referred to Cannelton, Pa., in a deposit just below d its discovery was credited to Mr. Mansfield, when it should referred to Mr. Lacoe, in whose collection it bears the num- This error of location was unfortunately repeated in my ects of North America, and in my Index to Known Fossil ull. 71, U. S. Geol. Survey).

IPTION OF A FRAGMENT OF A GIGANTIC FORE WING.

MYLACRIDÆ (?) sp.

Pl. II, fig. 4.

est fragment of a fore wing, consisting only of the humeral wn here to draw attention to an unknown species remarka- immense size and for the surface structure. It seems to be ainly a cockroach, and appears to have rather the aspect of group than that of one of the Blattinariæ. The shoulder g is apparently penetrated by a single straight vein without branches, unless the doubly forked bent prominence may be an extreme basal branch. The entire surface is covered with little, circular, shallow punctures, about 0.28 mm. in diameter, slightly more deeply impressed at their margins than centrally, sparsely distributed with considerable uniformity, but rather more closely crowded toward the margin, where they lie at an average distance apart of four or five of their diameters. The fragment is 25 mm. long, but, being only the merest fragment of the shoulder of a fore wing, must represent one very much larger than the largest known species, or perhaps one 80 mm. long, at the least.

The specimen comes from the Lowest Productive Coal-measures of Mazon Creek, Illinois, and was sent me for examination by Mr. William Gurley.

BLATTINARIÆ.

This group of Palæoblattariæ was the prevailing type of cockroaches in Carboniferous times. In America they are found from the Millstone Grit (in scanty numbers, but some variety—two or three genera) to the Trias, where the species, mostly belonging to generic groups characteristic of the Trias, are only two or three times more abundant than in the Millstone Grit, though the culmination of the group is reached in the Permian. In Europe they have been discovered neither so low as the Millstone Grit nor so high as the Trias, but are found throughout the true Productive Coal-measures, as well as in the Barren Coal-measures (where they appear to have culminated) and in the Permian. This latter statement may require some revision when the numerous species found in the Productive Coal-measures at Commentry, France, are made known, just as a very different statement regarding the American rocks would have had to be made fifteen years ago.

Twelve genera and about 174 species are known, of which 10 genera and about 112 species come from America, and 8 genera and about 62 species from Europe, besides half a dozen undetermined species from the latter. Six of the genera are common to both worlds, 4 are peculiar to America (one of them to the Trias), and 2 to Europe. No species are known to occur on both continents.

6. Genus MICROBLATTINA (*μικρός*, Blattina, nom. gen.) gen. nov.

The apical half of a fore wing from the Rhode Island coal field presents such very striking peculiarities that they must be regarded as affording sufficient ground for distinct generic reference unless the unknown basal portion should show the veins to be connected in a very different way from what seems probable. It is as small as the smallest known Carboniferous cockroach, but probably of the normal form. The mediastinal area reaches but little beyond the middle of the tegmina and must be narrow. The scapular vein is simple and straight for more than half its length, and only when it reaches the end of the mediastinal area throws out numerous short branches to the margin. The externomedian vein runs parallel to the scapular and terminates above the apex of the tegmina, emitting numerous inferior, long, straight and parallel, nearly longitudinal branches to the apical margin. The internomedian area is rather narrow, at least in the distal half of the tegmina, subparallel to the inner margin, reaches out as far or nearly as far as the scapular area, and is filled with less crowded, arcuate veins, their convexity apical. The anal area is not preserved.

It is barely possible that what I have here taken for the scapular vein may be an anterior branch of what is regarded as the externomedian, similar to what is found in some of the species of that strange genus Oryctoblattina; but the other parts of the tegmina below this are at decided variance with the peculiar characteristics of Oryctoblattina, and hardly allow room for the development of the lower veins. If my interpretation of the neuration is correct, Microblattina must find a place near Etoblattina, but separated from it and its allies by the remarkable fact that the branches of the externomedian vein are inferior and not superior, just as in Anthracoblattina, where the mediastinal area is long.

A single species is known, coming from the Rhode Island coal field, which belongs in all probability to the Lowest Productive Coal-measures.

MICROBLATTINA PERDITA sp. nov.

Pl. III, fig. 5.

Unfortunately the basal half of the tegmina of this interesting species is destroyed, but the portion preserved shows that the tegmina were of slender ovate form, probably rather more than two and a half times longer than broad; the costal margin is very gently convex, the inner margin nearly straight, and the tip somewhat broadly rounded. The mediastinal area comes into the preserved fragment just enough to show that it was slender, with short, simple, arcuate branches, and that it reached somewhat beyond the middle of the tegmina, terminating somewhat abruptly. The scapular vein, as soon as it begins to fork (just before the extremity of the mediastinal area), approaches the margin less rapidly, increasing its length so that it extends nearly to the apex of the tegmina and crowds closely against the externomedian; its branches are very closely crowded, arcuate and simple, except for the forked basal branch. The externomedian vein first branches probably not beyond the end of the proximal third of the tegmina, and its parallel and straight branches shorten and become more crowded toward the extremity. Some of them are apically forked, and apparently what appear to be the basal ones, each of which is apically forked, are united at their base. What can be seen of the internomedian area is nearly riband-shaped, the main vein approaching the inner margin very gradually until just before its termination, when it curves down to it much as in the case of the mediastinal vein, and its branches, which are more distant than those of other parts of the tegmina and mostly simple, take on the arcuation of this apical part of the vein. None of the anal area is preserved. The externomedian vein and its branches, except next the border, appear in strong relief, while all the others are delicately incised, particularly those of the internomedian area. The whole surface is uniformly black and there is no sign of any other sculpture.

Length of fragment, 4 mm.; probable length of tegmina, 8 mm.; breadth, 3 mm.

From the Lower (?) Productive Coal-measures of East Providence R. I.; in the collection of Mr. R. D. Lacoe, No. 2092*a*.

7. Genus ARCHIMYLACRIS.

Archimylacris Scudd., Daws., Acad. Geol., 2d ed., 388 (1868).

Archimylacris is one of the few genera found in the Millstone Grit as well as later; but, unlike the other genera occurring there, it is at no time a prevailing type, nor does it occur later than the true Productive Coal-measures, nor indeed above its lowest members in the Eastern Interior coal field, in which a single species occurs; the oldest species occurs in the Pennsylvania coal basin, the youngest in the Acadian coal basin. In the light of our present knowledge, therefore, Archimylacris may be looked upon as one of the most primitive types of cockroaches, for it has been found in the earliest beds that have yielded these insects, and no generic type has been extinguished at an earlier epoch than it. Of the genera existing as early as the Lowest Productive Coal-measures, all have been recovered in later rocks excepting Microblattina and Necymylacris, but these two genera are not known, like Archimylacris, at a still earlier epoch. The genus has not yet been recognized in the European rocks.

Table of the species of Archimylacris.

a^1. Tegmina of nearly equal width throughout; anal area hardly extending beyond the basal third of the tegmina .... 1. *A. parallela.*

a^2. Tegmina oval throughout, nowhere with parallel margins; anal area extending considerably beyond the basal third of the tegmina.

  b^1. Tegmina fully two and a half times longer than broad, the mediastinal area distinctly tapering throughout its distal half .... 2. *A. paucinervis.*

  b^2. Tegmina only twice as long as broad, the mediastinal area scarcely tapering before its extreme tip .... 3. *A. acadica.*

1. ARCHIMYLACRIS PARALLELA.

Archimylacris parellela Scudd., Mem. Bost. Soc. Nat. Hist., III, 85–87, pl. 6, fig. 6 (1879); Foss. Ins. N. A., I, 105–107, pl. 6, fig. 6 (1890).

From Campbell's Ledge, near Pittston, Pa., near the bottom of the Millstone Grit, where it was discovered by Mr. R. D. Lacoe, in whose collection it bears the number 2007. In the original description it was wrongly referred to the Lowest Productive Coal-measures at Cannelton, Pa., and as collected by Mr. Mansfield. The same error is unfortunately repeated in my Fossil Insects of North America and in my Index to Known Fossil Insects (Bull. 71, U. S. Geol. Survey).

2. ARCHIMYLACRIS PAUCINERVIS.

Archimylacris paucinervis Scudd., Mem. Bost. Soc. Nat. Hist., IV, 411-414. pl. 31, fig. 5 (1890); Foss. Ins. N. A., I, 387-390, pl. 23, fig. 5 (1890).

From the Lower Productive Coal-measures at Mazon Creek, Illinois.

3. ARCHIMYLACRIS ACADICA.

Archimylacris acadica Scudd., Daws., Acad. Geol., 2d ed., 388, fig. 153 (1868); Mem. Bost. Soc. Nat. Hist., III, 84-85, pl. 6, figs. 8, 14 (1879); Foss. Ins. N. A., I, 104-105, pl. 6, figs. 8, 14 (1890).

Found in shale overlying the roof of the main seam of coal at the East River, Pictou, Nova Scotia.

8. Genus SPILOBLATTINA.

Spiloblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 35-36 (1885).

So far as known this genus is peculiar to the American Trias, four species occurring in Colorado. It is very closely related to Etoblattina, and especially to the species of that genus from the latest Carboniferous deposits with open neuration, and it is no doubt an offshoot from that genus, which existed side by side with it or comes of similar parentage with it.

Table of the species of Spiloblattina.

- *a*¹. Scapular vein as far as its penultimate branch almost completely parallel to the costal margin, not receding from it opposite the middle of the adjoining discal stigma.
  - *b*¹. Tegmina relatively slender, fully three times as long as broad.
    - *c*¹. Scapular faintly approaching the externomedian vein to inclose the stigma between them .... 1. *S. gardineri.*
    - *c*². Scapular in no way approaching the externomedian vein to inclose the stigma between them .... 2. *S. triassica.*
  - *b*². Tegmina relatively broad, not over two and a half times longer than broad. 3. *S. guttata.*
- *a*². Scapular vein distinctly receding from the costal margin opposite the middle of the adjoining discal stigma .... 4. *S. marginata.*

1. SPILOBLATTINA GARDINERI.

Spiloblattina gardineri Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 36 (1885); Mem. Bost. Soc. Nat. Hist., IV, 461-462, pl. 41, figs. 4, 6, 8, 10 (1890); Foss. Ins. N. A., I, 437-438, pl. 33, figs. 4, 6, 8, 10 (1890).

Trias of Fair Play, Colo.

2. SPILOBLATTINA TRIASSICA.

Spiloblattina triassica Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 36 (1885); Mem. Bost. Soc. Nat. Hist., IV, 461, 462-463, pl. 4, fig. 1 (1890); Foss. Ins. N. A., I, 437, 438-439, pl. 33, fig. 1 (1890).

Trias of Fair Play, Colo.

3. SPILOBLATTINA GUTTATA.

Spiloblattina guttata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 36–37 (1885); Mem. Bost. Soc. Nat. Hist., IV, 461, 463, pl. 41, fig. 2, pl. 42, fig. 14 (1890); Foss. Ins. N. A., II, 437, 439, pl. 33, fig. 2, pl. 34, fig. 14 (1890).

Trias of Fair Play, Colo.

4. SPILOBLATTINA MARGINATA.

Spiloblattina marginata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 37 (1885); Mem. Bost. Soc. Nat. Hist., IV, 461, 464, pl. 41, fig. 3 (1890); Foss. Ins. N. A., I, 437, 440, pl. 33, fig. 3, (1890).

Trias of Fair Play, Colo.

9. Genus ETOBLATTINA.

Etoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 56–58 (1879); Foss. Ins. N. A., I, 76–78 (1890).

This might be termed the typical genus of Palæoblattariæ, or at least of Blattinariæ, for it was the prevailing type in the Carboniferous and Permian periods, containing very nearly one-half of the known Paleozoic cockroaches, and in America almost exactly one-half. Ninety-seven species have already been recognized—sixty-nine in this country and twenty-eight in Europe—yet a dozen years ago only two species were recognized in this country. The great increase is due to the discovery of the localities at Richmond, Ohio, and Cassville, West Virginia, at which places all but fourteen of the new American species have occurred. Even in the older rocks it holds a predominant position, being there equaled in number only by Mylacris in America, while in Europe it has nearly treble the number of species belonging to Gerablattina or Anthracoblattina, its nearest numerical neighbors. Its number in America is also treble, or a little more than treble, that of Gerablattina, which follows it among Blattinariæ. Not a single species is common to Europe and America, nor in America has a single one been certainly found at two distinct localities.

In accordance with the fact of its predominance is that of its endurance, since in this country it has been recognized in every deposit which has yielded remains of cockroaches, from the Millstone Grit, where a single species occurs in the Western Interior coal field,[1] to the Trias, from which, in Colorado, two species have been recognized. This can not be said of any other genus of cockroaches. It reaches its culmination in the Permian, where it is found in astonishing abundance in the Dunkard Creek series of West Virginia, whence thirty-six species are known from the single locality of Cassville, Monongalia County. Every coal basin in this country from which cockroaches are known, except the Acadian, has furnished some species of this genus. In the true Productive Coal-measures they have been found most abundantly in the

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[1] This refers to *E. venusta*, found by Lesquereux in Arkansas deposits regarded by him as of this age, but according to the latest surveys it is more probable, Mr. Lacoe informs me, that the deposits belong to the Lower Productive Coal-measures, in which case the above statement must be modified.

Rhode Island basin (eight species); but in the Barren Coal-measures of eastern Ohio seventeen species occur, which is a number larger than that of all the species from the Productive Coal-measures from all American localities combined, indicating the ascendancy of the group.

At the same time, the deposits of the Barren Coal-measures and of the Permian rocks present a new type, already referred to in the Introduction and pretty easily recognized at a glance by the slenderness of the tegmina combined with an exceptional openness of the neuration in the middle of the tegmina, the latter feature somewhat recalling the Triassic Spiloblattina, though with a slightly different effect. So far as the present material shows, this type was the prevailing one in the Barren Coal-measures of this country, but seems to have been only less prevalent in the Permian. It was not peculiar to America, for it appears in the European Permian species, *E. elongata.* I have not attempted, as perhaps I should have done, to bring all these species together in the following table, but they are grouped to a certain extent in a subordinate manner.

In Europe, also, Etoblattina was the predominating type of cockroaches and has been found in every successive series of rocks in which cockroaches have been found, from the Lowest Productive Coal-measures to the Permian. It seems to have reached its climax in the upper Carboniferous deposits, corresponding largely to our Barren Coal-measures. For assistance in studying the European forms, I have added in the Introduction a section upon the European species of the genus, with a key for their determination.

The following table has been constructed with much difficulty; and while it brings in juxtaposition many of the nearly allied species in a natural manner, it separates at the same time whole series, which a more complete knowledge of the neuration from more perfect examples would have enabled me to arrange in a better order by their judicious mingling. It is offered only as a temporary convenience. The sequence of the species in the table is followed in the text and as far as possible in the plates.

Table of the species of Etoblattina.

a^1. Relatively broad species; tegmina distinctly less than two and one-half times longer than broad.
  b^1. Mediastinal area less than two-thirds the length of the tegmina.
    c^1. Internomedian area terminating far short of the apex of the tegmina.
      d^1. Mediastinal area triangular, continuously tapering, reaching only the middle or a little beyond the middle of the tegmina.
        e^1. Scapular vein terminating at the very apex of the tegmina; externomedian vein first forking beyond the middle of the tegmina. 1. *E. clintoniana.*
        e^2. Scapular vein terminating before the extreme apex of the tegmina; externomedian vein first forking far before the middle of the tegmina .... 2. *E. lata.*
      d^2. Mediastinal area vittate, tapering only at extremity, reaching far beyond the middle of the tegmina.

Table of the species of Etoblattina—Continued.

e^1. Externomedian vein first forking at about the middle of the tegmina, the branches mostly simple.................... 3. *E. sagittaria.*

e^2. Externomedian vein first forking near the end of the proximal third of the tegmina, the branches mostly forked.... 4. *E. mediana.*

c^2. Internomedian area nearly reaching the tip of the tegmina.

d^1. Tegmina only twice as long as broad; veins rather numerous. 5. *E. fossa.*

d^2. Tegmina much more than twice as long as broad; veins very numerous.

e^1. Large species, the tegmina exceeding 50 mm. in length; mediastinal area reaching far beyond the middle of the tegmina. 6. *E. illustris.*

e^2. Small species, the tegmina less than 12 mm. long; mediastinal area only extending to the middle of the tegmina........ 7. *E. ovata.*

b^2. Mediastinal area at least two-thirds as long as the tegmina.

c^1. Tegmina only twice as long as broad; mediastinal area not more than two-thirds as long as the tegmina.............. 8. *E. scholfieldi.*

c^2. Tegmina considerably more than twice as long as broad; mediastinal area nearly or quite three-fourths as long as the tegmina.

d^1. Internomedian area terminating far before the tip of the tegmina.

e^1. Scapular and externomedian veins nearly united in basal third of tegmina; internomedian vein normal .... 9. *E. debilis.*

e^2. Scapular and externomedian veins clearly distinct throughout; internomedian vein peculiar.

f^1. Externomedian vein simple, unbranched; internomedian vein reinforced by a supplementary branched superior stem. 10. *E. strigosa.*

f^2. Externomedian vein abundantly branched; internomedian vein very strongly sinuate, the area apically very slender. 11. *E. clarkii.*

d^2. Internomedian area extending nearly to the tip of the tegmina, 12. *E. venusta.*

a^2. Relatively slender species, the tegmina two and one-half or more times longer than broad.[1]

b^1. Tegmina distinctly less than three times as long as broad.

c^1. Internomedian area not or hardly attaining the apical margin.

d^1. Veins in center of tegmina much more widely separated than those on the apical margin.

e^1. Mediastinal area considerably more than two-thirds the length of the tegmina.

f^1. Internomedian branches distant and most of them forked. 13. *E. balteata.*

f^2. Internomedian branches crowded and most of them simple. 14. *E. patiens.*

e^2. Mediastinal area somewhat or distinctly less than two-thirds the length of the tegmina.

f^1. Scapular and externomedian veins first branching at very unequal distances from the base.

g^1. Externomedian and internomedian branches very crowded, more so than the branches of the other veins..... 15. *E. mucronata.*

g^2. Externomedian and internomedian branches, especially the latter, not crowded, and not more so than the others. 16. *E. detecta.*

f^2. Scapular and externomedian viens first forking side by side. 17. *E. occidentalis.*

d^2. Veins in center of tegmina scarcely more widely separated than those on the apical margin.

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[1] In a few species the tegmina are barely two and one-half times, in a few others they are more than three times longer than broad.

Table of the species of Etoblattina—Continued.

ediastinal area less than three-fifths the length of the tegmina.
Tegmina sparsely veined............................ 18. *E. exigua.*
Tegmina abundantly veined.
^{1}. Main scapular vein nearly straight................. 19. *E. sp.* (R. I.).
^{2}. Main scapular vein strongly arcuate.
h^1. Scapular vein subparallel to the costal margin in the basal half of the tegmina; its branches oblique...... 20. *E. jeffersoniana.*
h^2. Scapular vein forming a considerable angle with the costal margin in the basal half of the tegmina, its branches longitudinal .... 21. *E. residua.*
ediastinal area more than three-fifths the length of the tegmina.
Anal furrow terminating hardly or not beyond the end of the proximal two-fifths of the tegmina.
^{1}. Veins of internomedian area not crowded; scapular and externomedian veins well separated from the base .. 22. *E. funeraria.*
^{2}. Veins of internomedian area crowded; scapular and externomedian veins united in the proximal fourth of the tegmina.
23. *E. expuncta.*
Anal furrow terminating scarcely short of the middle of the tegmina.
24. *E. gorhami.*
omedian area distinctly attaining the apical margin.
is in center of tegmina widely separated.
ediastinal area less or scarcely more than one-half the length of the tegmina.
Internomedian vein nearly straight, nearly all the branches simple.
. Internomedian area narrow, in the middle less than one-fourth the width of the tegmina....................... 25. *E. aperta.*
. Internomedian area relatively broad, in the middle nearly one-third the width of the tegmina.................. 26. *E. fasciata.*
Internomedian vein strongly sinuate, many of the branches forked, often doubly forked.
. Mediastinal vein arcuate beyond base; scapular vein scarcely bent at the origin of the first two branches .... 27. *E. ramosa.*
. Mediastinal vein straight beyond base; scapular vein distinctly bent at the origin of the first two branches .... 28. *E. willsiana.*
diastinal area nearly or quite three-fifths the length of the tegmina.
Externomedian vein first branching close to the middle of the tegmina.
. Internomedian vein arcuate throughout, continually approaching the margin............................ 29. *E. lesquereuxii.*
. Internomedian vein sinuous by a distinct apical extension, subparallel to the margin.
h^1. The branches of the mediastinal vein mostly originate from the vein itself.
i^1. Main scapular vein broadly sinuate; internomedian vein nearly reaching the very apex of the tegmina.
j^1. Costal margin broadly arcuate; first two branches of scapular vein widely separated at origin............ 30. *E. maledicta.*
j^2. Costal margin strongly arcuate; first two branches of scapular vein closely approximate at base.......... 31. *E. benedicta.*
i^2. Main scapular vein rigidly straight through most of its course; internomedian vein falling considerably short of the apex.
32. *E. funesta.*
h^2. Most of the branches of the mediastinal vein arise from its first branch, which imitates the mediastinal vein. 33. *E. exsensa.*

Table of the species of Etoblattina—Continued.

f^2. Externomedian vein first branching well within the proximal half of the tegmina.

g^1. Mediastinal vein about three-fifths the length of the tegmina; scapular vein forking before the externomedian vein. 34. *E. tenuis.*

g^2. Mediastinal vein two-thirds the length of the tegmina; externomedian vein forking before the scapular vein.. 35. *E. hustoni.*

d^2. Veins in center of tegmina not widely separated.

e^1. Mediastinal area distinctly less than two-thirds the length of the tegmina.

f^1. Anal furrow striking the margin not beyond the end of the proximal third of the tegmina.

g^1. Internomedian area more than one-third the breadth of the tegmina in the middle of their distal half.......... 36. *E. persistens.*

g^2. Internomedian area less than one-third the breadth of the tegmina in the middle of their distal half.......... 37. *E. eakiniana.*

f^2. Anal furrow striking the margin but little before the middle of the tegmina.

g^1. Small species; tegmina with strongly convex costa; externomedian vein first branching before the tip of the anal furrow and well before the middle of the tegmina..... 38. *E. accubita.*

g^2. Large species; tegmina with gently convex costa; externomedian vein first branching beyond the tip of the anal furrow and scarcely before the middle of the tegmina... 39. *E. mazona.*

e^2. Mediastinal area fully two-thirds the length of the tegmina.

f^1. Scapular vein first forking scarcely before the externomedian vein.

g^1. Mediastinal area scarcely if any more than two-thirds the length of the tegmina.

h^1. Internomedian area reaching the apex of the tegmina by the retroarcuation of the main vein............... 40. *E. expulsata.*

h^2. Internomedian area reaching only the extreme limit of the apical margin of the tegmina, without noticeable retroarcuation.

i^1. Mediastinal branches excessively longitudinal and crowded; scapular branches mostly forked................ 41. *E. gratiosa.*

i^2. Mediastinal branches normal and not crowded; scapular branches all simple.................................. 42. *E. macerata.*

g^2. Mediastinal area almost or quite three-fourths the length of the tegmina.................................. 43. *E. immolata.*

f^1. Scapular vein first forking at a noticeable distance before the externomedian vein.

g^1. Anal furrow striking the margin scarcely beyond the end of the proximal two-fifths of the tegmina.

h^1. Mediastinal area three-fourths the length of the tegmina, tapering rather abruptly............................ 44. *E. mactata.*

h^2. Mediastinal area scarcely if any more than two-thirds the length of the tegmina, tapering gently........... 45. *E. communis.*

g^2. Anal furrow striking the margin scarcely before the middle of the tegmina................................. 46. *E. sp.* (Colo.).

b^2. Tegmina almost or fully three times as long as broad.

c^1. Mediastinal area less than two-thirds the length of the tegmina.

d^1. Internomedian vein more or less, often considerably, sinuate, much of the apical portion nearly or quite parallel to the inner margin, and rarely falling at all short of the apex of the tegmina.

Table of the species of Etoblattina—Continued.

. Scapular vein forking before, generally long before, the externomedian; anal area normal.

f^1. Mediastinal area less than half as long as the tegmina. 47. *E. hastata.*

f^2. Mediastinal area more than half as long as the tegmina.

g^1. Costal margin nearly straight throughout the middle half[1].

h^1. Internomedian area scarcely narrowing in its proximal half. 48. *E. marginata.*

h^2. Internomedian area rapidly narrowing in its proximal half. 49. *E. gracilenta.*

g^2. Costal margin regularly arcuate throughout........ 50. *E. exsecuta.*

Scapular vein first forking later than the externomedian; anal area exceptionally long and narrow................. 51. *E. arcta.*

nternomedian vein nearly or quite straight, the area tapering almost regularly and falling considerably, sometimes far, short of the apex of the tegmina.

Internomedian vein terminating well beyond the middle of the distal half of the tegmina.

^{1}. Main scapular vein strongly sinuous.................... 52. *E. stipata.*

^{2}. Main scapular vein nearly straight throughout.

g^1. Anal furrow striking the inner margin well beyond the end of the proximal third of the tegmina............. 53. *E. prædulcis.*

g^2. Anal furrow striking the inner margin far before the end of the proximal third of the tegmina.................. 54. *E. variegata.*

nternomedian vein terminating at or before the middle of the distal half of the tegmina.

. Externomedian vein strongly bent where first forked and thereafter very oblique................................ 55. *E. hilliana.*

. Externomedian vein gently bent where first forked and thereafter but little or scarcely oblique.

g^1. Tegmina scarcely tapering apically before the distal fourth, nearly equal in the middle half; internomedian area extending but little further than the mediastinal.

h^1. Tegmina more than three times as long as broad; internomedian area exceptionally narrow; externomedian vein first branching but little beyond the tip of the anal furrow. 56. *E. angusta.*

h^2. Tegmina less than three times as long as broad; internomedian area of normal breadth; externomedian vein first branching well beyond the tip of the areal furrow.... 57. *E. macilenta.*

^{2}. Tegmina tapering from the middle, the middle half fusiform; internomedian area extending very much farther than the mediastinal.

h^1. Internomedian area in middle less than one-third the breadth of tegmina; anal area excessively slender........ 58. *E. exilis.*

h^2. Internomedian area in middle more than one-third the breadth of the tegmina; anal area normal................ 59. *E. rogi.*

tinal area more than two-thirds the length of the tegmina.

rnomedian vein reaching nearly or quite to the apical margin of the tegmina.

in veins separated in the center of the tegmina by hardly wider intervals than the branches near the apical margin.

Scapular and externomedian veins distinct throughout.

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[1] This is not clear, but probable, in *E. marginata.*

Table of the species of Etoblattina—Continued.

g^1. Internomedian area just failing to reach the apical margin.
  h^1. Mediastinal branches not crowded; internomedian branches rarely forked; anal area elongate .... 60. *E. expugnata.*
  h^2. Mediastinal branches crowded, internomedian branches mostly forked; anal area abbreviate .... 61. *E. obatra.*
g^2. Internomedian area distinctly reaching the apical margin.
  h^1. Mediastinal branches crowded, mostly forked; scapular and externomedian veins first forking close together 62. *E. imperfecta.*
  h^2. Mediastinal branches not crowded, rarely forked; scapular vein first forking well before the externomedian.. 63. *E. secreta.*
f^2. Scapular and externomedian veins united in basal fourth or more of the tegmina .... 64. *E. reliqua.*
e^2. Main veins separated in the center of the tegmina by much wider intervals than the branches near the apical margin.
f^1. Scapular and externomedian veins both first forking in the distal half of the tegmina................................ 65. *E. invisa.*
f^2. Scapular and externomedian veins both first forking well within the proximal half of the tegmina.
  g^1. Externomedian vein distinctly oblique, the branches distinctly superior.
    h^1. Internomedian vein strongly sinuate, curving just beyond the anal furrow in an opposite sense to it .... 66. *E. occulta.*
    h^2. Internomedian vein arcuate almost to the tip.... 67. *E. latebricola.*
  g^2. Externomedian vein longitudinal, the branches purely furcate and longitudinal................................ 68. *E. defossa.*
d^2. Internomedian vein falling distinctly short of the apical margin of the tegmina .... 69. *E. recidiva.*

The hind wings described in the following list are not included in the table, nor is the fragment shown on Pl. XII, fig. 2.

1. ETOBLATTINA CLINTONIANA sp. nov.

Pl. IV, fig. 1

Tegmina broad subovate, two and a quarter times as long as broad, the costal margin beyond the well-shouldered base very faintly convex, the anal area full, and beyond it the inner margin symmetrical with the costal; the apex well rounded. Mediastinal area triangular, rapidly tapering, terminating before the middle of the tegmina and slightly before the tip of the anal furrow; the vein has only three or four simple, nearly straight, very oblique branches. The scapular vein runs subparallel to and distant from the costal margin nearly through the middle of the tegmina, straight in the greater part of its course, but arcuate in opposite senses at the two extremities, terminating exactly at the apex of the tegmina; it first forks as far toward the base as the internomedian vein, and has about eight gently arcuate branches, mostly simple, but others more or less deeply or doubly forked, all very oblique and the distal ones sublongitudinal. The externomedian vein runs parallel to the preceding, diverging but little from it when, beyond the middle of the tegmina, it first branches and is unimportant, having but a couple of branches, one simple, the other forked. The internomedian vein is gently arcuate, runs parallel to the externomedian and strikes the inner margin just before the distal tenth of the tegmina; it has five or six mostly simple sweeping branches. The anal furrow is rather strongly impressed, very regularly and strongly arcuate, and nearly reaches the middle of the tegmina; the anal veins are numerous, arcuate, crowded, mostly simple, and avoid the space adjoining the anal furrow.

Length of tegmina, 22.5 mm.; breadth at anal furrow, 10 mm. (broader at the middle of the anal area).

The surface of the tegmina, especially in the distal half and in the internomedian area, is covered by very delicate cross lines between the nervures, not very closely crowded.

This species, represented by a nearly perfect fore wing, is more nearly allied to the European *E. primæva* than to any of ours; it is about two-thirds its size and differs in its lesser breadth, the greater brevity of the mediastinal area, and the far later forking of the externomedian vein.

From the Lowest Productive Coal-measures at Gilkerston Ford, near Clinton, Mo., collected by David White, United States Geological Survey. No. 2182; original No. 412.

2. ETOBLATTINA LATA sp. nov.

Pl. IV, fig. 2.

Although the only known specimen of this species is imperfect by the loss of both extremities of the tegmina, they are apparently a little less than two and a half times as long as broad, the costal margin rather gently convex, the inner margin straight, and the apex well rounded. The mediastinal area is distinctly triangular and tapering throughout, terminating shortly before the distal end of the middle fifth of the tegmina, with few and distant, straight, very oblique, simple or forked branches. The scapular vein is broadly sinuate throughout, terminates at a little distance before the extreme apex of the tegmina, first branches within the basal fourth of the tegmina, and has about five nearly longitudinal, simple, forked, or doubly forked branches. The externomedian vein is also broadly sinuate, first forks opposite the tip of the anal furrow, and has four or more longitudinal, gently arcuate, simple or forked branches occupying the apical margin. The internomedian vein is feebly sinuate and probably terminates well before the extreme apex of the tegmina, and has six or seven mostly simple, strongly oblique, nearly straight branches, the first of which, deeply forked, originates far before the others, close to the very base of the vein. The anal furrow is deeply impressed, bent arcuate, and strikes the inner margin at about the end of the proximal third of the tegmina; the anal veins are simple, very gently arcuate, and subequidistant. The anal and internomedian veins are finely traced in black on the surface of the tegmina, otherwise of the color of the dark stone; and there are straight and crowded delicate cross lines between all the nervures.

Length of fragment, 10.5 mm.; probable length of tegmina, 16 mm.; breadth, 6.75 mm.

This species is most nearly allied to *E. sagittaria*, a considerably larger species, but differs from it in the form of the tegmina, the triangular and not vittate form of the mediastinal area, the far earlier branching of the externomedian vein, and the considerable difference in the character of the internomedian area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; No. 2099*a*.

3. ETOBLATTINA SAGITTARIA sp. nov.

Pl. IV, fig. 3.

The tegmina are twice as long as broad, have an ovate form, tapering rather regularly from about the middle of the anal area, with subacuminate rounded apex; the costal margin is gently arcuate, as is also the distal half of the inner margin. The mediastinal area is narrow, in its middle hardly a fifth the breadth of the tegmina, and ends with the middle fifth of the same; its branches are few, distant, simple, straight, and oblique. Scapular vein gently sinuate, subparallel to the inner margin and terminating almost at the very apex of the tegmina; it has five branches, the first arising within the proximal fourth of the tegmina, the second about the middle of the tegmina, these two forked or doubly forked, the remainder arising at regular intervals and simple; all are longitudinally oblique and gently arcuate. The externomedian vein is strongly sinuate, especially arcuate at base, first forks about the middle of the tegmina and has from three to five simple or forked, straight, longitudinal branches, arising at equal intervals in the distal half of the tegmina. The internomedian vein is strongly sinuate, parallel to the preceding but slightly approaching it distally, where the area is prolonged and attenuated, reaching the distal fifth of the tegmina; the seven or eight branches are mostly simple, slightly arcuate and oblique, the distal branches more strongly than the basal. The anal furrow is feebly impressed, very regularly and strongly arcuate and strikes the inner margin just beyond the end of the proximal two-fifths of the tegmina; the anal branches are few, subequidistant, arcuate, and simple. The surface of the tegmina shows no sign of cross-lining.

Length of preserved portion of tegmina, 11 mm.; probable length of tegmina, 12.8 mm.; breadth, 6.5 mm.

In its form and the apically attenuate internomedian area this species closely resembles *E. deanensis* of England, but differs strikingly from it in both the mediastinal and externomedian areas. It nevertheless appears to be closer to that than to any other European species, though it more nearly approaches our *E. mediana*. Were it not for the apical attenuation of the internomedian area, it would bear a strong resemblance to a Petrablattina, on account of the simplicity and longitudinality of its straight externomedian branches.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; four specimens, Nos. 2100 *a*, *b*, *c*, *d*.

4. ETOBLATTINA MEDIANA.

Pl. IV, fig. 4.

Tegmina somewhat less than two and one-half times as long as broad, tapering rather rapidly on apical half, subacuminate at apex, the costal margin rather strongly arcuate, the inner margin nearly straight to the end of the internomedian area and then rapidly arcuate. Mediastinal area vittate, terminating at the distal end of the middle fifth of the tegmina with somewhat distant, nearly straight, strongly oblique, mostly simple branches. Scapular vein gently arcuate beyond the base, terminating well short of the apex of the tegmina, with only three distant inequidistant branches, the first arising far toward the base, apically doubly forked, the next near the middle of the tegmina and deeply forked, the third simple. The externomedian vein is of unusual importance and has a sinuous course to make room for the apical extension of the following vein; it first forks not far beyond the middle of the proximal half of the tegmina and has four inequidistant, apically arcuate branches, which fork at unequal distances from the margin, the last simple. The internomedian vein is sinuate by the apical extension of its attenuated tip and reaches to the distal fifth of the tegmina; its branches are few, distant, arcuate, simple or deeply forked, the proximal oblique, the distal nearly longitudinal. The anal furrow is very feebly impressed, greatly arcuate, and strikes the inner margin not far beyond the end of the proximal fourth of the tegmina; the anal area is not preserved. The surface of the tegmina is marked with closely crowded delicate cross lines between the nervures, and the latter are faintly and finely traced in black. The basal third of the tegmina is lost in the single specimen known.

Length of fragment, 12 mm.; probable length of tegmina, 17 mm.; breadth, 7.5 mm.

This species differ from *E. sagittaria* by the far greater importance of the externomedian area, but seems to be more nearly allied to it than to any other species.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; No. 2101 *a*–*b*.

5. ETOBLATTINA FOSSA sp. nov.

Pl. IV, fig. 5.

Tegmina scarcely more than twice as long as broad, the inner margin nearly straight, the costal rather strongly convex, the apex broadly rounded. Mediastinal area broad at base, rapidly narrowing beyond the middle, terminating just beyond the middle of the tegmina; the branches few, mostly simple, straight and very oblique. Scapular vein strongly sinuate, in the middle subparallel to the costal margin, terminating close to the apical margin, first branching in the middle of the proximal half of the tegmina, with few gently arcuate branches, but the proximal ones deeply forked or compound, and all longitudinally oblique. Externomedian vein rather strongly sinuate, first branching a little before the middle of the tegmina, the branches few but mostly doubly forked and longitudinally arcuate. Internomedian vein parallel to the externomedian, terminating a little before the extreme apex of the tegmina, two branches which are doubly forked thrown off in the proximal fourth of the tegmina, and only one or two (simple?) beyond. Anal furrow finely impressed, regularly arcuate but apically straight and nearly transverse, terminating beyond the proximal two-fifths of the tegmina. The surface is glistening, carbonaceous, and distinctly marked with crowded and very irregular delicate cross lines, in places becoming reticulate. The lower part of the tip of the tegmina is broken off from the only specimen known, and the shoulder of the base is lost, with the anal area.

Length of fragment, 12.4 mm.; probable length of tegmina, 14 mm.; breadth, 6.75 mm.

This species closely resembles the next two, but the neuration is much less close, and the branching of the internomedian vein very different, most of the area being taken up with the offshoots of the first two branches.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston, No. 182.

6. ETOBLATTINA ILLUSTRIS.

Pl. IV, fig. 11.

Etoblattina illustris Scudd., Bull. U. S. Geol. Surv., No. 101, 12–13, pl. 2*i* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket (?), R. I.

7. ETOBLATTINA OVATA sp. nov.

Pl. IV, fig. 6.

Tegmina of a very symmetrical long ovate form, somewhat more than twice as long as broad. Mediastinal area fully half as long as the tegmina, the branches of the vein not numerous, gently arcuate, and mostly simple. Scapular vein nearly straight, with only a gentle arcuation at the extremities, subparallel to the costal margin and terminating scarcely before the extreme apex of the tegmina; it first branches in the middle of the proximal half of the tegmina, and has half a dozen very oblique and straight branches, simple or doubly forked. Externomedian vein straight and longitudinally oblique in its middle half, but arcuate at the extremities, terminating a little below the apex of the tegmina, thus occupying but an inconsiderable space on the margin; in the single specimen before me it first forks a little before the middle of the tegmina and has four branches, but the first is blind, the second deeply forked, the others simple, and all longitudinal. The internomedian vein is broadly sinuate, especially by the apical prolongation of the area, nearly to the apex of the tegmina, and is supplied with numerous branches, all, so far as can be seen, simple and arcuate, the proximal oblique, the distal longitudinal. The anal furrow is rather deeply impressed, strongly arcuate and probably mesially bent, terminating a little before the middle of the tegmina; the anal veins are numerous and crowded, strongly arcuate, and most of them very deeply forked. The carbonaceous black surface is indistinctly marked with rather close and irregular tremulous cross lines.

Length of fragment, 13 mm.; probable length of tegmina, 14.5 mm.; breadth, 6.25 mm.

This species is tolerably distinct from any of the known species of Etoblattina, but is perhaps most nearly allied to *E. illustris*, from which it differs in every known point of structure, and in particular in its feebly developed externomedian area, not to mention the extreme disparity in size, the present species having tegmina less than one-fifth as long as *E. illustris.*

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2102*a*.

8. ETOBLATTINA SCHOLFIELDI.

Pl. IV, fig 7.

Etoblattina scholfieldi Scudd., Bull. U. S. Geol. Surv., No. 101, 15, pl. 2, fig. *b* (1893).

From the Lower (?) Productive Coal-measures of East Providence, R. I.

9. ETOBLATTINA DEBILIS sp. nov.

Pl. IV, fig. 8.

Tegmina oval, tapering from before the middle, about two and one-fourth times longer than broad, the costal border strongly convex, especially in basal half, the inner margin nearly straight, except at base and apex, and the apex probably well rounded. Mediastinal area vittate, about a fourth of the width of the tegmina, apically tapering gradually, and terminating scarcely beyond the distal end of the middle third of the tegmina, the branches tolerably numerous, straight, oblique or very oblique, and rarely forked. The scapular and externomedian veins run so closely together in the proximal fourth of the tegmina as often with difficulty to be distinguished; beyond this the former is nearly straight and ends scarcely above the extreme apex of the tegmina; the branches are simple or deeply forked, nearly straight and oblique, the first originating sometimes as early as the middle of the proximal half of the tegmina. The externomedian vein, nearly as soon as it distinctly parts from the scapular, is straight and longitudinally oblique with three or four simple or forked straight branches parallel to the scapular vein. The internomedian vein is strongly arcuate at base, straight beyond, and terminates not far from the middle of the distal half of the tegmina; its branches are only three or four in number, but they are often deeply forked or doubly forked, nearly straight, and with a general oblique course. The anal furrow is very sharply depressed, very strongly arcuate before the straight apex, which strikes the inner margin at the end of the proximal two-fifths of the tegmina; the anal veins next the furrow are bent arcuate, the distant ones oblique and nearly straight, all simple, and the latter much more crowded than the former. The basal portion of the mediastinal vein is almost as much impressed as the anal furrow, and the interval between it and the scapular vein at the extreme base of the tegmina roundly ridged. The surface of the tegmina is of the color of the stone, but the internomedian and anal veins are finely traced in black; excessively crowded fine cross lining appears everywhere between the nervures, especially in the faintly vaulted anal area.

Length of largest fragment, 13 mm.; probable length of tegmina, 17 mm.; breadth, 7.5 mm.

This species somewhat resembles *E. strigosa*, especially in the close basal alliance of the scapular and externomedian veins, but it differs considerably from any species with which one would be disposed to compare it. One of the specimens (No. 2103 *c–d*) does not have the scapular and externomedian veins united to so great a distance as described.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; three specimens, Nos. 2103 *a–b*, *c–d*, *e*.

10. ETOBLATTINA STRIGOSA.

Pl. IV, fig. 10.

Etoblattina strigosa Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 52–53 (1889).

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone in the valley of Wills Creek, Richmond, Jefferson County.

11. ETOBLATTINA CLARKII.

Pl. V, fig. 10.

Etoblattina clarkii Scudd., Bull. U. S. Geol. Surv., No. 101, 14–15, pl. 2, fig. *j* (1893).

From the Lower (?) Productive Coal-measures at Pawtucket, R. I.

12. ETOBLATTINA VENUSTA.

nusta Lesq., Second Rep. Geol. Ark., 314, pl. 5, fig. 11 (1860).
venusta Scudd., Mem. Bost. Soc. Nat. Hist., III, 70–72, pl. 6, fig. 12 (1879); ns. N. A., I, 90–92, pl. 6, fig. 12 (1890).

ayou, Arkansas, in deposits regarded by Lesquereux[1] as hav- 200 to 300 feet of Millstone Grit above them, but which I am by Mr. R. D. Lacoe, basing his judgment upon the maps and f the later Arkansas surveys, more probably belong to the luctive Coal-measures, or the upper "coal-bearing division" of Final reports on the district have not yet been published, her season's fieldwork may be required to furnish a complete ation. In the present paper I have assumed provisionally the of Lesquereux's determination, though the presumption is not or.

13. ETOBLATTINA BALTEATA.

balteata Scudd., Mem. Bost. Soc. Nat. Hist., III, 110–112, pl. 6, figs. 9,); Rep. Second Geol. Surv. Penn. PP, 104, pl. 38, figs. 5, 5*a* (1880); Foss. A., I, 130–132, pl. 6, figs. 9, 10 (1890).
alteata Scudd., Proc. Bost. Soc. Nat. Hist. XXIV, 46, 48 (1889).

he Waynesburg coal (Lower Permian) of Cassville, W. Va.; ps from Bellaire, Ohio, in the Barren Coal-measures in shales ow the Pittsburg coal.

e of the species comes from Cassville. The fragment from composed of the anal area only, and it is quite impossible to er it belongs to this or an allied species.

14. ETOBLATTINA PATIENS sp. nov.

Pl. IV, fig. 9.

slender, nearly three times as long as broad, the costal mar- ry strongly but very regularly arcuate, the inner margin ight, the apex probably well rounded, tapering from the mid- egmina. Mediastinal area vittate, the vein parallel to the ically tapering and reaching nearly to the middle of the dis- the tegmina, the branches moderately numerous, oblique, nd simple. The scapular vein is unusually straight and scarcely above the extreme apex of the tegmina; it divides lle of the proximal half of the tegmina into two longitudinal ach further subdivided only beyond the middle of the teg- upper or first branch into a double fork, simulating the of the apical part of the mediastinal vein, the lower or main everal inequidistant branches, some at least probably forked. dian vein also very straight and longitudinally oblique, first ore the middle of the tegmina, the branches distant, only three or four in number, the first two oblique, the others compound. Internomedian vein similarly straight, though probably a little arcuate at tip (where it is broken in the only specimen seen), terminating probably a little before the apical margin of the tegmina, the branches rather numerous, subequidistant, increasingly oblique the farther from the anal area, arcuate and simple. Anal furrow delicately impressed, not greatly arcuate, terminating at the distal end of the proximal two-fifths of the tegmina. The surface of the tegmina is very broadly banded with black along the veins, between which run rather closely crowded, delicate, irregular cross lines, conspicuous only in the blackened portions.

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[1] See Geol. Mag., V, 177 (1868).

Length of fragment, 13 mm.; probable length of tegmina, 18 mm.; breadth, 6.4 mm.

This species is closely allied to *E. balteata*, from which it differs principally in the far more numerous and simple internomedian branches, and in the earlier forking of the scapular vein; it is also related not distantly to the European *E. russoma* and probably has the apex, as there, well filled with numerous veinlets, but the costal margin is far less arcuate, and the main veins in *E. russoma* are not nearly so straight as here. It also shows many points of resemblance to our *E. occulta*.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2104 *a–b*.

15. ETOBLATTINA MUCRONATA sp. nov.

Pl. V, fig. 3.

A large part of the base is lost from the only specimen of this species seen, but the tegmina are apparently somewhat less than three times as long as broad, of a lanceolate form, the apical half tapering somewhat rapidly and regularly, the apex subacuminate and sharply rounded. The mediastinal area is triangular, apically attenuate, reaching nearly to the distal end of the middle fifth of the tegmina, first forking at about the end of the proximal third of the tegmina, with three or four arcuate, longitudinally oblique, deeply forked or doubly forked branches, the apical branch simple. Externomedian vein very feebly sinuate, first forking at about the middle of the tegmina, with four branches having a course similar to that of the scapular branches, simple or forked, the last multiforked. Internomedian vein very feebly sinuate, almost straight, terminating well before the apex, but at the edge of the apical margin, with very numerous, nearly straight, crowded, simple, oblique branches. The surface of the tegmina is uniformly blackish, with the feeblest possible signs of distant straight cross lines between the nervures. The anal area and furrows are lost.

Length of fragment, 9.5 mm.; probable length of tegmina, 13.5 mm.; breadth, 5 mm.

This species bears a certain resemblance to *E. expuncta*, but is of much slenderer form, more tapering apically, and has more oblique and more complicated externomedian branches; the internomedian area is also longer in the present species; besides which there is in *E. expuncta* no such wide separation of the nervures in the middle of the wing as here.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; No. 2105 *a–b*.

16. ETOBLATTINA DETECTA sp. nov.

Pl. IV. figs. 12, 13.

Tegmina long ovate, considerably less than three times as long as broad, with the costal margin very strongly arcuate at base, nearly straight beyond the proximal third of the tegmina, the inner margin nearly straight, and the apex subacuminate, falling above the middle line of the tegmina. The mediastinal area is very slender and tapering, terminating well before the distal end of the middle third of the tegmina, with few very oblique, straight, simple branches. Scapular vein nearly straight, terminating near the beginning of the apical margin, first forking well before the middle of the tegmina with about four very inequidistant, longitudinal or longitudinally oblique, simple or deeply forked, sometimes doubly forked, straight or slightly arcuate branches. Internomedian vein distant from the externomedian, straight or sinuate, terminating at about the middle of the distal half of the tegmina with generally simple, rather distant, parallel, oblique, arcuate branches. Anal furrow very strongly and very regularly arcuate, rather deeply impressed, terminating not far from the middle of the proximal half of the tegmina; anal veins irregularly arcuate, inequidistant and subparallel, simple and moderately numerous. The surface of the tegmina is heavily banded with black along the nervures, so broadly as often to blend with the neighboring bands, and the interspaces are traversed pretty regularly and closely with distinct straight cross lines.

Length of tegmina, 16.5 mm.; breadth, 6.25 mm.

Two specimens are before me which differ considerably in the internomedian vein, which in one is straight and apically divaricate from the externomedian vein, and this latter forks relatively far from the base, while in the other specimen the internomedian vein is sinuous, apically convergent with the externomedian vein, and this latter forks relatively near the base. The latter specimen is nearly perfect; the former has lost a little of both base and apex.

This species is more nearly allied to the two preceding than to any others known to me, but is sufficiently distinguished from *E. mucronata* by its form and the relatively small number of internomedian branches, as well as by the earlier forking of the externomedian vein, and from *E. patiens* by the very different mediastinal area. It is, on the whole, nearer the latter.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2106 *a–b*, *c*.

17. ETOBLATTINA OCCIDENTALIS.

Etoblattina occidentalis Scudd., Mem. Bost. Soc. Nat. Hist., IV, 410–411, pl. 32, fig. 4 (1890); Foss. Ins. N. A., I, 386–387, pl. 24, fig. 4 (1890).

Lawrence, Kans. Dr. S. W. Williston, of the University of Kansas, tells me that the locality at which it was found, in the old fair ground near the city, is at about the middle of the true Carboniferous of Kansas, as nearly as he can make it out.

18. ETOBLATTINA EXIGUA sp. nov.

Pl. V, fig. 4.

Tegmina somewhat less than three times as long as broad, the inner margin straight, the costal margin strongly arcuate, but much less so in the apical half, the apex probably well rounded. Mediastinal area triangular, the vein being straight and terminating well before the distal end of the middle third of the tegmina; the branches are obscure but probably very longitudinally oblique and few in number. The scapular vein is broadly sinuate, terminating just above the extreme apex of the tegmina; it has but very few, three or four, very longitudinally oblique, feebly arcuate branches, mostly simple, their course parallel to the mediastinal vein. The externomedian vein is arcuate and has but two longitudinal branches, the first originating in the center of the tegmina and forked to its root, the other not far before the margin; probably all three of these are forked next the apical margin (broken in the only specimen). The internomedian vein is arcuate at first, straight apically, and terminates a little beyond the middle of the distal half of the tegmina; the branches are few in number and distant, the first one deeply forked, the others simple, straight, and oblique. The anal furrow is not very strongly arcuate, deeply impressed only in its basal half, and terminates a little beyond the end of the proximal third of the tegmina; the anal veins are few, distant, simple, parallel, subequidistant, and arcuate. The basal portion of the mediastinal vein is impressed as deeply as the anal furrow, while the basal portions of the externomedian and internomedian veins are borne on the summit of a ridge between them. The surface of the tegmina is blackish brown and all the nervures are bordered for fully a fourth of the distance to the neighboring nervures with black, more distinctly in the anal area than elsewhere; and there is a feeble very crowded straight cross lining between the nervules.

Length of fragment, 9.25 mm.; probable length of tegmina, 11.75 mm.; breadth, 4.2 mm.

This species is remarkable for the paucity of its neuration, and is not closely allied to any other species yet known.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2107 *a–b*.

19. ETOBLATTINA sp.

Pl. V, fig. 2.

Etoblattina sp. Scudd., Bull. U. S. Geol. Surv., No. 101, 18, pl. 2, fig. *h*, (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

20. ETOBLATTINA JEFFERSONIANA sp. nov.

Pl. V, fig. 7.

The only specimen of this species is a fragment from the middle half of the tegmina, with striking neuration; probably the tegmina were about two and a half times as long as broad, with both costal and inner margins gently convex, indicating a very regular oblong-obovate form. On this hypothesis, the mediastinal vein extended considerably beyond the middle of the tegmina, nearly to the distal end of the middle fifth, and was vittate, tolerably broad, with rather distant, parallel, straight, oblique branches. The scapular vein is extraordinarily distant from the mediastinal, strongly and regularly arcuate, and terminates probably short of the apical margin; it first forks just beyond the middle of the proximal half of the tegmina, and has about five inequidistant branches, which are long, arcuate, and simple or deeply, rarely doubly, forked, having the same trend as the mediastinal branches. The externomedian vein is broadly arcuate, first forks a little within the proximal two-fifths of the tegmina, and has about four longitudinal branches, the earlier ones compound and gently arcuate, the later ones simple or forked and nearly straight. The internomedian vein is broadly sinuate, the area being apically and very gradually attenuate, and probably reaching beyond the scapular area, with branches which are gently arcuate, simple, oblique, and become more and more longitudinal, about as distant as the mediastinal branches. The surface of the tegmina is uniformly carbonaceous, and there is no sign of any cross lines.

Length of fragment, 15 mm.; probable length of tegmina, 23.5 mm.; breadth, 9.5 mm.

This species bears some resemblance to the European *E. ornatissima*, but from the imperfection of the latter the scapular areas can not be compared; it seems, however, to have been in this direction wholly unlike our species. *E. jeffersoniana* also somewhat resembles our *E. gratiosa*, but differs entirely in the length and character of the mediastinal area and the peculiarities of the scapular venation.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, Nos. 186 and 184.

21. ETOBLATTINA RESIDUA sp. nov.

Pl. V, fig. 1.

A portion only of one of the tegmina is preserved in the only specimen of this species seen, lacking the entire costal margin, but the greater part of the neuration is preserved and shows a peculiar species. The tegmina are apparently about two and a half times longer than broad with a nearly straight inner margin; the costal margin was probably somewhat strongly arcuate and the apex subacuminate, the tegmina tapering from before the middle. A fragment only of the mediastinal vein is preserved, showing the area to have been remarkably narrow, terminating before the distal end of the middle fifth of the tegmina. The scapular vein is rather strongly sinuate, and terminates somewhat before the apex of the tegmina; it first forks before the tip of the anal furrow, hardly beyond the basal fifth of the tegmina, and probably has five or six simple or forked, long, straight, and remarkably longitudinal branches. The externomedian vein is similarly sinuate, first forks but little beyond the scapular and has but two branches, the second emitted near the middle of the tegmina, the branches doubly forked or compound, gently arcuate and longitudinal. The internomedian vein is strongly sinuate, apically very attenuate, but fails even to reach the apical margin; it has seven or more rather distant branches, the proximal nearly straight, the distal arcuate and longitudinally oblique. The anal furrow is strongly arcuate, scarcely impressed, terminating at the end of the basal fourth of the tegmina, so that the area is remarkably abbreviated. The surface is uniformly black and the interspaces traversed by rather crowded delicate cross lines.

Length of fragment, 11 mm.; probable length of tegmina, 15.5 mm.; breadth of fragment, 5.25 mm.; probable complete breadth, 6 mm.

This species seems to be most nearly, but not closely, allied to *E. jeffersoniana*, but differs from it in form, in the narrowness of the mediastinal, scapular, and apical portion of the internomedian areas, and in the totally different formation of the scapular mode of branching.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2131*a*.

22. ETOBLATTINA FUNERARIA sp. nov.

Pl. V, fig. 5.

Tegmina oval, two and a half times as long as broad, the inner margin straight before the apex, the costal margin strongly and pretty regularly convex, the apex probably well rounded. The mediastinal area is vittate, rather narrow, almost two-thirds as long as the tegmina, with rather few, inequidistant, straight or arcuate, simple, strongly oblique branches. The scapular vein is nearly straight but feebly and very broadly sinuate, terminating at no great distance before the apex of the tegmina; it first forks at the end of the proximal third of the tegmina, and has five or six very oblique feebly arcuate branches, which are apically forked at a distance from the margin equal to the width of the mediastinal area. The externomedian vein, at first arcuate, is thereafter nearly straight, longitudinally oblique and apically faintly arcuate; it first forks just beyond the scapular vein, and in the middle of the tegmina has three longitudinally and gently arcuate forked or doubly forked branches. The internomedian vein is arcuate, very feebly except at base, and terminates long before the apex of the tegmina with five or six rather distant, simple, arcuate, oblique or longitudinally oblique branches. The anal furrow is strongly bent arcuate, strongly impressed, and terminates somewhat beyond the end of the proximal third of the tegmina; the anal veins are simple, at first distant and arcuate, then sinuate, then proximate and straight, in passing from the anal furrow. All the nervures, but especially those of the anal area, are strongly and rather broadly edged with black, giving the whole a funereal appearance, and in the anal and internomedian areas, and to a faint degree elsewhere, are distinct cross lines closely crowded and straight between the nervules.

Length of largest fragment, 14.5 mm.; probable length of tegmina, 17.5 mm.; breadth, 7 mm.

This species is of the type of *E. russoma* of Europe, from which it differs mainly in the characteristics of the scapular vein, and the small number of externomedian veinlets. It also resembles, in many points, some of our own species, such as *E. exsecuta*, from which it may be separated by its broader and less attenuated internomedian area, which feature, as well as the relatively greater breadth of the tegmina, separates it from *E. accubita* and *E. expulsata*.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2108 *a–b*, *c*.

23. ETOBLATTINA EXPUNCTA sp. nov.

Pl. V, fig. 6.

Tegmina a little more than two and a half times longer than broad, ovate, with gently arcuate costal border, very gently arcuate inner border and probably well-rounded apical border. Mediastinal area vittate, apically attenuate, reaching slightly beyond the distal end of the middle third of the tegmina; the branches few, simple, straight, and longitudinally oblique. Scapular and externomedian veins apparently united in the proximal fourth of the tegmina, the scapular thereafter straight and terminating at the very apex; it first forks almost immediately after its freedom from the externomedian vein and before the middle of the tegmina, and has at least three longitudinally oblique gently arcuate branches, all arising before the middle of the distal half of the tegmina and all deeply forked, the first very deeply and doubly forked. The externomedian vein is bent at parting from the scapular and is thereafter straight and oblique, and has four or five subequidistant, straight, simple, longitudinal branches. Internomedian vein arcuate at base, beyond straight, terminating in the middle of the distal two-fifths of the tegmina, with numerous and crowded, mostly simple, straight, oblique branches. The anal furrow is concealed in the only specimen seen by the slipping forward of the partially detached anal area, but the vaulting of the latter indicates that it was deeply impressed, pretty strongly arcuate, and terminated at about the end of the proximal third of the tegmina; anal veins numerous, gently arcuate, mostly simple, but some deeply forked. The surface of the tegmina is uniformly black, apparently delicately shagreened and there is no trace of cross lines.

Length of fragment, 11 mm.; probable length of tegmina, 15 mm.; breadth, 5.75 mm.

The species is somewhat allied to *E. mucronata*, but has an altogether different mediastinal area, with no such tapering form of the tegmina. *E. debilis* has the same basal union of the scapular and externomedian veins, but that species has much broader tegmina and very different internomedian branches. *E. russoma* is its nearest European ally, but it is very different from that species at nearly every point.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2109 *a–b*.

24. ETOBLATTINA GORHAMI.

Pl. V, fig. 8.

Etoblattina gorhami Scudd., Bull. U. S. Geol. Surv., No. 101, 17–18, pl. 2, fig. *a* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

25. ETOBLATTINA APERTA sp. nov.

Pl. V, fig. 9.

Although only the middle half of one of the tegmina of the specimen on which this species is based is preserved, it retains nearly all the most characteristic features of the tegmina and is so remarkable that it can not be passed by. To judge by the margins preserved and by the course of the veins and their branches it had a tapering oval form, the tegmina considerably less than three times as long as broad, and probably tapering from near the middle of the proximal half apexward. The mediastinal vein appears on the fragment only by its tip, which reached but little beyond the middle of the tegmina, the branches very oblique. The scapular vein ran in a tolerably straight course not far above the middle line of the tegmina to a little beyond the center, when it curved strongly upward to the costal margin, which it struck not far ıe proximal end of the distal fifth of the tegmina; it probably ·ked not far beyond the proximal fourth of the tegmina and had ısiderably arcuate, oblique, simple or more or less deeply forked ·s. The externomedian vein is nearly straight, very distant e scapular, and has in the fragment only a single but very ınt and singular branch, which, unless there is a slight branch ıain vein near the tip, takes all the divarication that appertains ıain stem, for, curving in the same sense as the main scapular ı slightly approaching it, it throws off, subparallel to the main hree longitudinal and arcuate simple or forked branchlets. ernomedian vein, too, is peculiar; it lies at an extraordinary ı from the externomedian vein, and soon after its freedom from area runs completely parallel to the inner margin and at no stance from it, the area being in the middle less than a fourth ridth of the tegmina, and probably terminates on the apical where it curves around to meet its straight course; the branches ıle, distant, strongly arcuate and longitudinally oblique. The ins are heavily and broadly, the branches narrowly, margined ck, and there is very faint sign of crowded cross lining betwen ures.

ı of fragment, 9 mm.; probable length of tegmina, 16 mm.; 6 mm.

pecies is most nearly allied to *E. fasciata*, but differs from it in narrower internomedian area and the totally different neura- he externomedian vein. I formerly[1] regarded it as the same, ı can be little doubt of its distinctness.

the Waynesburg coal (Lower Permian) of Cassville, W. Va. . Lacoe; one specimen, No. 2066 *a–b*.

26. ETOBLATTINA FASCIATA.

Pl. V, fig. 11.

fasciata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 47–48, 1889.

cond specimen described under this name in the above-men- ıper (p. 48) was wrongly referred to this species and is here ı as *E. aperta*, No. 25. No further specimens of the present ave been found.

Barren Coal-measures of Ohio, less than 100 feet above the limestone, in the valley of Wills Creek, Richmond, Jefferson

27. ETOBLATTINA RAMOSA sp. nov.

Pl. V, fig. 12.

ıater and nearly all the important part of one of the tegmina em to be of a lanceolate form, but with the costal far more arcuate than the inner margin, with a probably strongly rounded somewhat pointed apex, the whole about two and a half times longer than broad. The mediastinal vein is straight and subparallel to the arcuate margin in the middle of its course, and roundly bent toward the margin at the origin of its last offshoot, ending scarcely beyond the middle of the tegmina; the branches are distant, gently arcuate, strongly oblique and apically narrowly forked. The scapular vein is nearly straight, but apically slightly arcuate, terminating a little below the apex of the tegmina; it first forks a little beyond the proximal fourth of the tegmina and has four or five branches, which are strongly or longitudinally oblique, more or less sinuous, and deeply and sometimes doubly forked. The externomedian vein is nearly straight, but apically slightly sinuous and first forks scarcely before the middle of the tegmina, and has three or four inequidistant longitudinal branches, all simple or forked only apically if at all, together occupying only the narrow apical margin. The internomedian vein, at first straight, is afterward sinuous, retreating from and then advancing toward the externomedian vein, so as to leave a widened space between these main veins, much after the fashion of Spiloblattina, and terminating a little below the extreme apex of the tegmina; its branches are distant, longitudinally oblique and arcuate, all or nearly all more or less deeply, often doubly, forked or ramose. The anal furrow strikes the margin at about the end of the proximal third of the tegmina. The surface is black but with long, uncolored, fusiform patches in the wider interspaces, while in the blackened portions it is delicately, feebly, and minutely reticulate, the reticulations partially giving way in the internomedian area to tremulous cross lines.

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[1] Proc. Bost. Soc. Nat. Hist., XXIV, 48.

Length of fragment, 16 mm.; probable length of tegmina, 25 mm.; breadth, 10 mm.

This species certainly bears a close general resemblance to *E. hastata* from the same beds, but has a much stouter form and more strongly sinuous internomedian vein, besides larger mediastinal and anal areas; the peculiarities of the branching of each vein is, however, very similar.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston, No. 108.

28. ETOBLATTINA WILLSIANA sp. nov.

Pl. V, fig. 13.

Tegmina lanceolate, tapering from the basal third, more than two and one-half times longer than broad, the costal margin rather strongly and pretty regularly arcuate, the inner margin scarcely arcuate, the apex subacuminate and strongly rounded. Mediastinal area long triangular, the vein very straight and terminating scarcely beyond the middle of the tegmina, the proximal branches transversely oblique and straight, the distal oblique or very oblique and arcuate, all

Scapular vein broadly sinuate by the bending of the vein at
gin of the first two branches and its apical slight arcuation,
ating well before the apex of the tegmina; it has about half a
very oblique branches, the first branch arising near the middle
proximal half of the tegmina and nearly continuing the basal
of the main vein; the distal branches are simple, the others
forked, doubly forked, or compound. The externomedian vein
y sinuous, terminating below the apex of the tegmina, so that
iches occupy symmetrically the narrow apex; it has three dis-
gitudinal branches, the lower ones simple, the first, arising well
he middle of the tegmina, simple halfway to the tip, and then
pposite the second branch it is narrowly arborescent; it parts
owly from the main stem that the vein appears to have two
divergent, unequal, forking branches. The internomedian
strongly sinuate, though straight in the middle of its course,
inates as near the apex as the scapular vein; its branches are
istant, all but the apical and some of the proximal forked or
forked, the proximal oblique and gently arcuate, the distal
inally oblique and arcuate. The anal furrow can not strike
r margin far beyond the proximal third of the tegmina, but
ion is lost in the single specimen seen. The surface is car-
is black, with a loss of color in elongate patches in the inter-
nd the black portions are delicately and irregularly reticulate.
of fragment, 22.5 mm.; probable length of tegmina, 26.75
adth, 10.25 mm.

ecies is very closely allied to *E. ramosa*, but is distinguishable
y the straightness of the mediastinal vein, the angularity of
lar and the earlier forking and different mode of branching of
nomedian vein. Almost similar differences separate it from
ht veined *E. funesta*. In the peculiar formation of the exter-
area it bears some resemblance to the European *E. elongata*.

Barren Coal-measures of Ohio, less than 100 feet above the
limestone, in the valley of Wills Creek, Richmond, Jefferson
Mr. S. Huston, No. 176.

29. ETOBLATTINA LESQUEREUXII.

lesquereuxii Scudd., Mem. Bost. Soc. Nat. Hist., III, 67–69, fig., pl. 6, figs.
'9); Foss. Ins. N. A., I, 87–89, fig., pl. 6, figs. 3, 4 (1890).

e roof shales of the D seam of anthracite at Yatesville, near
Pa.

30. ETOBLATTINA MALEDICTA sp. nov.

Pl. VI, figs. 1–3.

oblong ovate, two and one-half or more times longer than
costal margin broadly arcuate, the inner margin mostly
the apex well rounded. Mediastinal area rather narrow,
tip acuminate, ending distinctly beyond the middle of the

by Google

tegmina; the branches moderately numerous, rarely forked, very oblique, gently arcuate. Scapular vein broadly sinuate, ending a very little before the apex, first forking somewhat beyond the proximal fourth of the tegmina, with about five inequidistant branches, which are mostly deeply forked or doubly forked, arcuate, and longitudinally oblique, the first generally arising far before the others. Externomedian vein beyond the strong basal arcuation very broadly sinuate, first forking at about the middle of the tegmina, with three simple or forked branches, all nearly longitudinal, occupying at tip the apical margin only of the tegmina. Internomedian vein broadly sinuate (it is drawn too straight in fig. 2), terminating almost or quite as near the apex as the scapular vein, its branches not very numerous, arcuate and oblique, mostly simple, but occasionally deeply forked. Anal furrow rather strongly arcuate, delicately impressed, terminating at the end of the proximal two-fifths of the tegmina; anal veins simple, next the anal furrow strongly arcuate, beyond sinuate and more crowded. Surface of the tegmina carbonaceous black, with more or less fusiform brown patches in the interspaces, the black portions marked with crowded, more or less tremulous and irregular cross lines.

Length of largest fragment, 23 mm.; probable length of tegmina, 25 to 29 mm.; breadth, 9.5 to 11 mm.

This species is closely allied to *E. variegata* and *E. stipata*, but is of a stouter form, with the main veins more curved than in the former, and with less abundantly branched scapular and externomedian veins than in the latter. One of the specimens (No. 165) differs from the others in that the first branch of the scapular vein is compound and carries a much larger share than usual of the scapular system, much as in No. 163 (fig. 2), but in a still more aggressive manner.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; seven specimens, Nos. 163, 164, 165, 170, 174, 181, 192.

31. ETOBLATTINA BENEDICTA sp. nov.

Pl. V, figs. 14, 15.

Tegmina about two and one-half times longer than broad, tapering from the end of the basal third, the costal margin very strongly arcuate, the inner margin nearly straight except at the extremities, the apex subacuminate but well rounded. Mediastinal area vittate, tapering only close to the tip, which reaches about to the distal end of the middle fifth of the tegmina; the branches rarely forked, slightly arcuate, and very oblique. The scapular vein is considerably sinuate and terminates well before the apex of the tegmina; it first forks a little beyond the basal third of the tegmina and has five or six branches, of which the first two arise close together; the branches are mostly forked pound, most of them considerably arcuate and very oblique . The externomedian vein beyond its strong basal arcuation is straight, but feebly arcuate in an opposite sense; it first forks e middle of the tegmina and has three branches which are longi- , nearly straight, and in the apical fourth of the tegmina forked pound. Internomedian vein strongly sinuate, much more y arcuate at base than apically, the area being apically te and yet terminating far before the apex of the tegmina; the branches are more or less arcuate, simple or apically forked and . The anal furrow is strongly arcuate, scarcely impressed, and tes before the end of the proximal third of the tegmina; the ns are in no instance preserved. The surface is precisely as in *dicta.*

h of large fragments, 16 to 22 mm.; probable length of tegmina, 4 mm.; breadth, 9 to 10 mm.

pecies is very closely allied to *E. maledicta*, and will possibly be be identical with it; it differs principally in the much stronger n of the costal border, the briefer extension of the interno- area, and the approximation at base of the first two branches capular vein. It seems to be equally abundant with *E. male-* d is with it the most common of the Richmond species. The specimens agree remarkably in the neuration of the scapular greatest difference being shown in the two selected for illus-

Barren Coal-measures of Ohio, less than 100 feet above the limestone, in the valley of Wills Creek, Richmond, Jefferson Mr. S. Huston; six specimens, Nos. 166 and 167, 168, 178, 179 183 and 193, 199.

32. ETOBLATTINA FUNESTA sp. nov.

Pl. VI, fig. 4.

a nearly three times as long as broad, lanceolate, tapering rom the middle, with broadly arcuate costal margin and feebly nner margin, the apex strongly rounded. Mediastinal area ly broad, tapering, terminating at about the distal end of the th of the tegmina, with strongly oblique, rather distant and simple or forked branches. Scapular vein exceedingly straight han its middle half, broadly arcuate apically, and ending just narrow apical margin; it first forks at about the end of the fourth of the tegmina, and has half a dozen straight or sin- ngly oblique or longitudinally oblique branches, most of them d sometimes compound. The externomedian vein beyond the gidly straight, scarcely bent where first forked, and has but f approximate branches, occasionally three, thrown off at the the tegmina and beyond, both branches straight and longitudinal, soon and almost simultaneously forked and probably again forked beyond. In contrast to these the internomedian vein is strongly sinuate (though nearly straight in its middle course), leaving a wide space between it and the externomedian vein, and terminates somewhat earlier than the scapular vein; its branches are not crowded, simple, or forked, mostly the former, gently arcuate and oblique. The anal furrow terminates short of the end of the proximal two-fifths of the tegmina. The surface of the tegmina is carbonaceous black, with large, elongate, pale patches in the larger interspaces, and there is feeble sign in a few places of delicate, not very crowded, cross lining.

Length of best fragment, 20 mm.; probable length of tegmina, 27 mm.; breadth, 9.5 mm.

The species is nearly allied to *E. tenuis*, from which it differs mainly in the later and different branching of the externomedian vein and the much more strongly sinuate course of the internomedian. It is a much slenderer species than the preceding, from which it differs in the straightness of the middle veins and in its slenderer form. There is a somewhat striking difference between two of the specimens in the straightness or sinuation of the scapular branches, and especially in the proximal.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Three specimens: Mr. S. Huston, Nos. 107 and 177, 180; United States Geological Survey, No. 2186.

33. ETOBLATTINA EXSENSA sp. nov.

Pl. VI, figs. 7, 8.

Tegmina slender and lanceolate, about two and one-half times longer than broad, to judge from the fragments preserved, which only show the central portions; the costal margin gently arcuate and the inner nearly straight. Mediastinal area vittate, tapering in its apical half, acuminate, reaching to about the distal end of the middle fifth of the tegmina, the veins very oblique, simple, and straight. Scapular vein faintly arcuate, terminating slightly before the extreme apex of the tegmina, first forking only a little before the proximal fourth of the tegmina, the first branch nearly longitudinal, and bearing most of the branchlets, which are similar to those of the mediastinal vein, but distinctly less oblique; the main vein forks again several times, the first at about the middle of the tegmina, the branches longitudinally oblique and forked (very likely compound). Externomedian vein nearly straight to about the middle of the tegmina, and then bent at the first fork, following a longitudinally oblique course toward the inner margin; it has two or more forked and, perhaps, compound branches. The internomedian vein is strongly sinuous, being straight and longitudinally oblique beyond the basal arcuation to near the middle of the tegmina, thereafter parallel or subparallel to the inner margin, and doubtless curving

oward it apically; its distant branches have a varying obliquity
e arcuate, and, at least beyond the basal ones, mostly forked or
forked. The anal furrow probably terminates at about the end
roximal third of the tegmina. The surface is black, with broader
ower elongate brown patches in the interspaces, sometimes reduc-
black to a narrow bordering to the nervures, though never
approaching the margin of the tegmina; over the black portions
seen a delicate, close, and tremulous cross lining.

th of fragments, 9 to 11 mm.; probable length of tegmina, 25 to
ı.; breadth, 10.5 to 11 mm.

species closely resembles *E. tenuis*, from which it differs prin-
in the great importance of the first scapular branch. It is
r distinguished from the two preceding species.

Barren Coal-measures of Ohio, less than 100 feet above the
l limestone, in the valley of Wills Creek, Richmond, Jefferson
Mr. S. Huston; two specimens, Nos. 161, 196.

34. ETOBLATTINA TENUIS.

Pl. VI, fig. 6.

ı *tenuis* Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 46–47 (1889).

ı the only one of our species with open and widely separated
ı in the center of the tegmina which bears any very close
nce to the single European species of that type, *E. elongata*
rom the Dyas, and it is very distinct from that.

Barren Coal-measures of Ohio, less than 100 feet above the
limestone, in the valley of Wills Creek, Richmond, Jefferson

35. ETOBLATTINA HUSTONI.

Pl. VI, fig. 9.

hustoni Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 53 (1889).

ıe same place as the last mentioned.

36. ETOBLATTINA PERSISTENS.

persistens Scudd., Mem. Bost. Soc. Nat. Hist., IV, 459–460, pl. 41, fig. 7;
figs. 10,[1] 19 (1890); Foss. Ins. N. A., I, 435–436, pl. 33, fig. 7, pl. 34 figs.
1890).

ıl an imperfect fragment of another and unnamed species are
ıost-Paleozoic Etoblattinæ known.

' Fair Play, Colo.

'ortunate error occurs in one of the plates of my paper on the "Triassic insects of Fair
ɔf the Memoirs of the Boston Society of Natural History, vol. 4; pl. 34 of my Fossil
-th America, vol. 1), caused by a rearrangement of the plate after the text was prepared
esponding change in the text; accordingly, the following changes should be made in the
-hed to the figures on this plate: Fig. 9 should be numbered 13; fig. 10, 9; fig. 12, 10;
. 15, 12; fig. 16, 15; and fig. 17 should be numbered 16. The text and plate will then

37. ETOBLATTINA EAKINIANA sp. nov.

Pl. VII, fig. 1.

Tegmina subovate, less than two and one-half times longer than broad, the costal margin strongly shouldered and beyond that gently and regularly arcuate, the inner margin straight, the apex probably well rounded. Mediastinal area vittate, tapering through almost the distal half, reaching to the distal end of the middle fifth of the tegmina, the branches of the vein rather close, mostly simple, increasingly oblique. Scapular vein broadly arcuate, terminating at less than halfway from the tip of the mediastinal vein to the apex of the tegmina, with two very longitudinally oblique, simple, arcuate branches arising about opposite the end of the anal furrow. Externomedian vein gracefully and uniformally sinuate, of far more importance than the scapular, first forking before the end of the proximal fourth of the tegmina, the first branch forking near the origin of the second branch, each fork again dividing halfway to the margin; the other three branches arise near together near the middle of the tegmina, and are simple or forked, all the branches arcuate, less so from above downward, and all nearly longitudinal. Internomedian vein sinuate like the preceding, terminating but little below the apex, the simple branches not crowded as in the two previous areas, slightly arcuate, oblique, and increasingly so in the distal half of the area. Anal furrow strongly and regularly arcuate, strongly impressed, terminating at the end of the proximal third of the tegmina; anal veins arcuate, simple, not numerous. The surface of the tegmina is uniformly black, with faint traces of exceedingly close cross lining in the internomedian area.

Length of fragment, 13 mm.; probable length of tegmina, 15.25 mm.; breadth, 6.5.

The characteristics of the scapular vein easily separate this from other species in the vicinity. It is named for Mr. C. L. Eakin, of Wadestown, W. Va., who has done good service in the exploitation of the locality at Cassville, which has yielded so many remains of Etoblattina.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2111 *a–b*.

38. ETOBLATTINA ACCUBITA sp. nov.

Pl. VII, fig. 2.

Tegmina nearly three times as long as broad, tapering from the middle in each direction, but more sharply toward the base than toward the apex, the costal margin being very strongly and rather regularly arcuate, the inner margin nearly straight, and the apex probably well rounded. Mediastinal area vittate, terminating at the distal end of the middle fifth of the tegmina, the vein with few mostly simple, nearly straight, strongly oblique branches. Scapular vein feebly arcuate beyond the basal sinuation, ending well before the apex of the tegmina, with three subequidistant, deeply forked or simple, longitudinally oblique branches, the middle one arising at the middle of the tegmina. Externomedian vein gracefully and rather strongly sinuate, with four mostly simple, slightly arcuate, longitudinal branches, the first arising scarcely later than the first scapular branch. Internomedian vein similarly arcuate, terminating slightly below the apex of the tegmina, the rather numerous branches mostly simple, very oblique, and feebly arcuate, the apical ones longitudinally oblique. Anal furrow less strongly arcuate than usual, terminating but little short of the middle of the tegmina; anal area destroyed in the only specimen seen. The surface is uniformly black, and there is everywhere the feeblest possible sign of close cross lining in the interspaces.

Length of fragment, 12 mm.; probable length of tegmina, 14.75 mm.; breadth, 5.25 mm.

The species is peculiar for the basal narrowing of the tegmina and the apparent length and slenderness of the anal area. It is not distantly related to *E. mazona* and other species, but differs at almost every point.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2112*ai*

39. ETOBLATTINA MAZONA.

Pl. VI, fig. 5. (See also fig. 3 on p. 31.)

Etoblattina mazona Scudd., Mem. Bost. Soc. Nat. Hist., III, 181, pl. 10 (1882); Proc. Bost. Soc. Nat. Hist., XXI, 392–396 (1882); Foss. Ins. N. A., I, 233, pl. 7*a* (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinois.

40. ETOBLATTINA EXPULSATA sp. nov.

Pl. VII, figs. 3, 4.

Tegmina lanceolate, nearly three times as long as broad, tapering from the middle of the proximal half, the costal margin strongly arcuate, especially basally, the inner margin straight, the apex well rounded. Mediastinal area vittate, apically very attenuate, reaching the distal end of the middle third of the tegmina, the branches of the vein rather numerous, nearly straight, simple and very oblique, the apical longitudinally oblique. Scapular vein uniformly and rather strongly sinuate, ending a little before the apex, first forking at or a little beyond the end of the proximal third of the tegmina, the branches, five or six in number, mostly simple, feebly arcuate or sinuate, longitudinally oblique. Externomedian vein sinuate, more strongly arcuate at base than at apex, first forking just beyond the first scapular fork, with three longitudinal forked or doubly forked branches. Internomedian vein strongly sinuate, the area extended nearly to the tip by its apical prolongation through a superior subramose offshoot from a little beyond the middle of the tegmina, the other branches mostly simple, arcuate, oblique, and more distant than the branches of other veins. Anal furrow strongly bent-arcuate, strongly impressed, and terminating a little beyond the end of the proximal third of the tegmina; anal area gently vaulted, the veins simple, strongly arcuate. The surface of the tegmina is blackish-brown, and the veins are marked and sometimes narrowly edged with black, while all the interspaces are traversed by very close straight or sinuate cross lines.

Length of one fragment, 14.5 mm.; probable length of tegmina, 16 mm.; breadth, 6 mm. Length of another fragment, 16.5 mm.; probable length of tegmina, 20 mm.; breadth, 7 mm.

This species is very closely allied to the next four or five species, but is sufficiently distinct from them all in the peculiar formation of the apical part of the internomedian area. The two principal specimens referred to here (and figured) differ a little in size and in the point of origin of the first scapular branch.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; three specimens, Nos. 2113 *a–b*, *c–d*, *e–f*.

41. ETOBLATTINA GRATIOSA sp. nov.

Pl. VII, fig. 5.

Tegmina ovate, somewhat less than three times as long as broad, the costal margin strongly arcuate throughout, the inner margin straight, the apex well rounded. Mediastinal area vittate, apically very attenuate, reaching fully to the distal end of the middle third of the tegmina, the branches of the vein simple, nearly straight, exceedingly oblique. Scapular vein gracefully, pretty uniformly and rather gently sinuate, subparallel to the inner margin, ending somewhat before the apex; it first branches a little beyond the proximal fourth of the tegmina, and has about five branches which have a longitudinal sweep and are mostly simply deeply and narrowly forked. The externomedian vein is strongly arcuate at the base, feebly sinuate, nearly straight in the middle and gently arcuate apically, first branching just beyond the scapular vein, and with four longitudinal, nearly straight, mostly forked branches, the forks of varying depths. Internomedian vein feebly sinuate, apically arcuate with no sign of special extension, yet terminating nearly as far out as the scapular vein; its branches are more distant than those of the other areas, simple or deeply forked, oblique and nearly straight. Anal furrow strongly bent-arcuate, deeply impressed except apically, terminating a little beyond the proximal third of the tegmina; anal veins strongly arcuate, simple or profoundly forked. The surface of the tegmina is uniformly blackish, and the interspaces are filled with crowded, straight, delicate cross lines.

Length of fragment, 16.5 mm.; probable length of tegmina, 18.25 mm.; breadth, 6.75 mm.

This species is closely allied to *E. expulsata* and has many of its special peculiarities, such as the strongly arcuate costa and the separation of the oblique internomedian veins, as well as the general distribution of the branches; but it differs from it distinctly in the structure of the extremity of the externomedian area. It also bears a close general resemblance to *E. exsecuta*, especially in the mediastinal, scapular and anal areas, but it differs from it at almost every other point. It bears also a general resemblance to the European *E. didyma*, but differs in almost every detail.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2114 *a–b*.

42. ETOBLATTINA MACERATA sp. nov.

Pl. VII, fig. 6.

Tegmina two and three-quarters times longer than broad, ovate, tapering from the middle of the proximal half, the costal margin rather strongly arcuate, especially in the proximal half, the inner margin straight, the apex well rounded. Mediastinal area vittate, apically attenuate, reaching the distal end of the middle third of the tegmina, the vein with few and rather distant, nearly straight, very oblique branches. Scapular vein broadly sinuate, terminating a little above the apex, first forking a little beyond the proximal third of the tegmina, the branches entirely similar to those of the mediastinal area, except in their greater length. Externomedian vein strongly sinuate, with four inequidistant, longitudinal, sinuate branches, simple or deeply forked, the first arising a little beyond the first scapular fork. Internomedian vein sinuate, terminating long before the apex of the tegmina, with branches about as distant as those of the mediastinal area, the proximal ones simple, gently sinuate and oblique, the distal mostly deeply forked, arcuate, and very oblique. Anal furrow strongly arched, deeply impressed, terminating scarcely short of the end of the proximal two-fifths of the tegmina; anal veins simple, strongly arcuate, distant. Surface very dark, all the veins edged narrowly, the anal veins broadly, with black, which is traversed by closely crowded straight cross veins.

Length of tegmina, 19.5 mm.; breadth, 7 mm.

This species is very closely allied to several others; the relative sparseness and simplicity of the scapular and mediastinal branches separate it from *E. expulsata* and *E. gratiosa*, and the lesser length of the mediastinal area from *E. immolata;* in the similarly early origin of the first branch of the scapular and externomedian veins it is distinct from *E. communis*, while the same characteristic and the greater stoutness of the tegmina distinguish it from *E. obatra* and *E. secreta;* from *E. obatra* it is still further separated by its simpler neuration.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2081 *a–b*, *c.*?

43. ETOBLATTINA IMMOLATA sp. nov.

Pl. VII, figs. 7, 8.

Tegmina somewhat more than two and a half times longer than broad, ovate, tapering from about the middle, with rather strongly arcuate costal margin (more strongly arcuate in some than in others), nearly straight inner margin and probably a well-rounded apex. Mediastinal area vittate, tapering only at extreme apex, reaching nearly to the middle of the distal half of the tegmina, the vein with simple, rarely forked, strongly oblique, nearly straight, rather abundant branches. Scapular vein more or less strongly sinuate, terminating somewhat short of the apex of the tegmina, first forking a little before a point opposite the tip of the anal furrow, with four or five simple or deeply forked, more or less arcuate, longitudinally oblique branches. Externomedian vein rather strongly sinuate, first forking scarcely beyond the scapular vein, with about four longitudinally arcuate, simple or perhaps apically forked branches. Internomedian vein gracefully and rather gently sinuate, terminating a little short of the apex of the tegmina, with six or eight arcuate, generally simple, very oblique branches. Anal furrow strongly arcuate, deeply impressed, terminating at just about the end of the proximal two-fifths of the tegmina; anal area gently vaulted, the veins rather numerous, strongly arcuate next the anal furrow, nearly straight in the opposite region. Surface exactly as in *E. macerata*.

Length of largest fragment, 14 mm.; probable length of tegmina, 17.75 mm.; breadth, 6.5 to 7 mm.

This species is closely allied to the three preceding species, but is sufficiently distinguished from them by the greater length of the mediastinal area, in which it approaches the genus Gerablattina. From the two following species, to which it is also very closely allied, it differs in the nearly simultaneous origin of the first branches of the scapular and externomedian veins.

The two specimens placed here differ rather unusually at one or two points, especially the arcuation of the costal margin, the breadth of the mediastinal area, and the number of internomedian branches.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, Nos. 2115 *a–b*, *c–d*.

44. ETOBLATTINA MACTATA sp. nov.

Pl. VII, fig. 9.

Tegmina two and three-quarters times longer than broad, ovate, the costal margin very regularly and gently arcuate, the inner margin nearly as arcuate, the apex doubtless strongly rounded. Mediastinal area vittate, tapering only beyond the middle of the tegmina, reaching almost to the middle of their distal half, the vein with moderately numerous, mostly simple, very oblique, straight branches. Scapular vein rather strongly sinuate, terminating a very little before the extreme apex of the tegmina, first branching at the end of the proximal third of the tegmina, with four or five subequidistant, arcuate, simple or forked branches, which apically have the same direction as the distal mediastinal branches. Externomedian vein strongly arcuate, first branching considerably later than the scapular vein, with three simple or deeply forked (probably reforked apically), nearly longitudinal but arcuate branches, occupying on the margin only the narrow apex of the tegmina. Internomedian vein strongly and very gracefully arcuate, terminating as near the apex as the scapular vein, with five deeply forked or simple branches, the proximal ones nearly straight and oblique, the distal arcuate and longitudinally oblique. Anal furrow very strongly arcuate except apically, sharply incised, terminating at about the end of the proximal two-fifths of the tegmina; anal area slightly vaulted, the veins gently or (toward the furrow) strongly arcuate, simple. Surface blackish brown, all the veins marked in black and perhaps delicately edged with the same, the interspaces with closely crowded straight cross lines.

Length of fragment, 15 mm.; probable length of tegmina, 18.5 mm.; breadth, 7.25 mm.

This species is separated from those which immediately precede it, and to which it is closely allied, by the relatively wide intervals between the origin of the first scapular and externomedian branches. It is still more closely related to *E. communis*, from which the greater length of the mediastinal area clearly separates it. One can not but be struck, also, by the rather strong general resemblance this insect bears to *Gerablattina concinna* from the same beds, but besides the generic distinctions between them (which are here indeed feeble), it differs in almost every detail as well as in the form of the tegmina. Of the European species it is most nearly allied to *E. dohrnii*, but not at all closely.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2116*a*.

45. ETOBLATTINA COMMUNIS sp. nov.

Pl. VII, figs. 10–17.

Tegmina ovate, somewhat more than two and a half times longer than broad, the costal margin gently and pretty regularly arcuate, the inner margin faintly arcuate, the apex strongly rounded. Mediastinal area vittate, apically acuminate, reaching nearly, sometimes quite, to the distal end of the middle third of the tegmina, the vein with relatively few, mostly simple, and nearly or quite straight, very oblique branches. Scapular vein faintly broadly sinuate, terminating shortly before the very apex of the tegmina, first forking at about the end of the proximal fourth of the wing, often a little after, rarely before it, the branches three to five in number, the first generally widely separated from the second, mostly deeply forked, rarely doubly forked, but always some of them simple, and all longitudinally oblique and arcuate. Externomedian vein broadly sometimes strongly arcuate, rarely uniform, first forking some distance later than the scapular, the branches from two to four, usually four, in number, longitudinal, more or less arcuate, some of them simple, others deeply but narrowly forked, often doubly forked or even compound. The internomedian vein is gracefully sinuate, more strongly arcuate basally than apically, and ends not far from the apex but generally farther than the scapular vein; the branches are more distant than in the other areas and most of them are simple and very oblique, the distal more oblique than the proximal, but the first and some of the last are often deeply forked, and occasionally the area is apically filled by simple oblique branchlets from a longitudinally oblique preapical branch. Anal furrow strongly arcuate, impressed, terminating at a little beyond the proximal third of the tegmina; anal area gently vaulted, the veins simple and arcuate, not crowded. Surface blackish brown, all the veins marked and narrowly margined with black and the interspaces filled with crowded straight cross lines.

Length of tegmina, 16 to 21 mm.; breadth, 6 to 8 mm.

The species is sufficiently distinguished from *E. mactata*, its nearest ally, by the briefer extent of the mediastinal area; and from the four preceding species, to which it is also closely related, by the wider separation of the points of origin of the first scapular and externomedian branches. It differs in the same feature, as also in the length of the mediastinal area, from *Gerablattina uniformis*, to which its general resemblance is very striking. It appears to be the commonest species in West Virginia, where ten specimens have been found.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, Nos. 2187 *a–b*, *c–d*, *e*, *f*, *g*, *h*, *i*, *j*, *k–l*, *m–n*.

46. ETOBLATTINA sp.

Etoblattina sp. Scudd., Mem. Bost. Soc. Nat. Hist., IV, 460, pl. 42, fig. 20 (1890); Foss. Ins. N. A., I, 436, pl. 34, fig. 20 (1890).

Triassic of Fair Play, Colo.

47. ETOBLATTINA HASTATA sp. nov.

Pl. VIII, fig. 1.

Tegmina lanceolate, tapering from a little beyond the middle of the proximal half, almost three times as long as broad, the costal margin very gently arcuate except at base and tip, where it is more strongly curved, the inner margin scarcely arcuate, the apex probably sharply rounded. Mediastinal vein straight until past the final branch, and then bent toward the margin, which it strikes before the middle of the tegmina, with rather distant, simple or narrowly forked, arcuate, very oblique branches. Scapular vein straight, terminating scarcely above the very apex of the tegmina, first branching before the end of the proximal fourth of the tegmina, the branches not numerous, inequidistant, longitudinally oblique, irregular and deeply forked, sometimes compound. Externomedian vein also straight, nearly parallel to the scapular throughout its course, first forking far beyond the scapular at about the end of the proximal two-fifths of the tegmina, the few branches nearly longitudinal, inequidistant, and, so far as preserved, simple. Internomedian vein irregularly sinuate, falling not far short of the apex of the tegmina, in the distal half of its course subparallel to the inner margin, the branches distant, inequidistant, mostly deeply forked or compound, some simple, arcuate and very oblique. Anal furrow terminating before the end of the proximal third of the tegmina. Surface uniformly carbonaceous, covered with a delicate tremulous reticulation.

Length of fragment, 17 mm.; probable length of tegmina, 27.25 mm.; breadth, 9.5 mm.

This species is evidently not distantly related to the apparently stouter species, *E. fasciata*, but has a very different internomedian area.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, No. 106.

48. ETOBLATTINA MARGINATA.

Pl. VIII, fig. 2.

Etoblattina marginata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 48-50 (1889).

From the same locality and horizon as the last.

49. ETOBLATTINA GRACILENTA sp. nov.

Pl. VIII, figs. 6, 7.

Tegmina almost exactly three times as long as broad, obovate, tapering but very little from about the end of the proximal third, the costal margin very strongly arcuate at base, beyond nearly straight to the rounded tip, the inner margin similarly straight, the apex rather broadly rounded. Mediastinal area narrow, vittate, but the feebly sinuate vein constantly approaching the margin in the apical half, reaching considerably beyond the proximal half of the tegmina, the branches of the vein not numerous, mostly deeply and narrowly forked, very strongly oblique. Scapular vein sinuate, much more strongly arcuate at base than beyond, where it is subparallel to the costal margin, with a varying but considerable number of inequidistant, longitudinally oblique branches, some of them arcuate, rarely simple, generally deeply forked, doubly forked or even compound, the first arising somewhat before the end of the proximal third of the tegmina. The externomedian vein, pretty strongly arcuate at the base, is thereafter nearly straight and subparallel to the scapular vein, but gradually parts slightly from it in the distal half of the tegmina; it first forks a little before the middle of the tegmina and has but three or four deeply and narrowly forked or compound longitudinal branches. The internomedian vein, after the basal arcuation, runs in a straight longitudinally oblique course to a little beyond the middle of the tegmina, when it curves so as to run a short distance parallel to the inner margin and then curves down to it, ending somewhat before the apex; most of its inequidistant branches are broadly and deeply forked and are increasingly oblique. Anal furrow sharply and deeply impressed, strongly arcuate and terminating slightly within the proximal two-fifths of the tegmina; the anal area is vaulted, the veins few, inequidistant, simple, those next the furrow bent-arcuate and distant, the others close and sinuate. Surface carbonaceous with feeble signs of cross lining in the interspaces.

Length of largest fragment, 28 mm.; probable length of tegmina, 28 to 29.5 mm.; breadth, 9 to 9.75 mm.

This species is easily distinguished from both *E. hastata* and *E. marginata* by the sinuation of the main veins, and from at least the former by its very different form. In its larger features the neuration resembles that of *E. willsiana*, but it is abundantly distinct from that species in every detail.

The two specimens figured differ somewhat and particularly in the length of the internomedian area, the apical space given to the externomedian area, and the proximal branches of the scapular area, which in one are more numerous and simpler than in the other.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; three specimens, Nos. 114, 198, and perhaps 105.

50. ETOBLATTINA EXSECUTA sp. nov.

Pl. VIII, fig. 4.

Tegmina long oval, almost three times as long as broad, tapering only from the middle, the costal margin strongly and very uniformly arcuate, the inner margin feebly arcuate, the apex pretty well rounded. Mediastinal area vittate, rather narrow, apically acuminate, terminating just before the end of the middle third of the tegmina, the branches of the vein rather few, straight, simple, and strongly oblique. Scapular vein gracefully and regularly sinuate, ending well before the apex of the tegmina, first forking just before the proximal fourth of the tegmina with about four arcuate branches having the same trend as the mediastinal branches, simple or deeply forked. Externomedian vein strongly sinuate, more arcuate basally than apically, first forking but little beyond the scapular, with five or six sinuate, longitudinal, simple or apically and narrowly forked branches, or with only two or three of such branches, one of them compound. Internomedian vein sinuate like the externomedian, terminating not very far short of the apex of the tegmina, with half a dozen branches, less crowded than those of the scapular and externomedian veins, arcuate and oblique, simple or deeply forked. Anal furrow strongly bent-arcuate, sharply impressed, terminating at the end of the proximal two-fifths of the tegmina, the anal veins simple, numerous, more distant, and strongly arcuate next, more crowded and straight or sinuate away from, the furrow. Surface uniformly blackish brown, with closely crowded, straight cross lines in all the interspaces.

Length of tegmina, 18.75 mm.; breadth, 6.5 mm.

This species is very closely related to *E. communis*, from which it differs in the stronger arcuation of the costal margin, its slenderer form, and the closer approximation of the first fork of the scapular and externomedian veins. It differs similarly from *E. macerata* except in the last-mentioned point, and that the scapular and externomedian branches are more crowded. It also bears a nearly similar relation to the still slenderer *E. secreta*, but it has a shorter mediastinal area and a less elongated anal area. From *E. expulsata*, to which it is also closely allied, it differs in its slenderer form, the much less arcuate costal margin, and the earlier forking of the scapular and externomedian veins.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; three specimens, Nos. 2120 *a–b*, *c–d*, *e*, besides two others probably belonging here.

51. ETOBLATTINA ARCTA sp. nov.

Pl. VIII, fig. 5.

Tegmina exceptionally long and slender, more than three and a half times longer than broad, about equally slender at both extremities, the costal margin more arcuate at base than next apex, nearly straight in the middle, the inner margin feebly arcuate at base, nearly straight beyond to the sloping tip, the apex subacuminate, very sharply rounded. Mediastinal area vittate, broad, tapering only at extreme tip, which reaches but little beyond the middle of the tegmina, the branches of the vein distant, simple, straight, oblique. Scapular vein broadly arcuate, in most of its course parallel to the costal margin, terminating at about the middle of the distal third of the tegmina, first forking scarcely before the middle of the tegmina, its branches wholly similar to the mediastinal. Externomedian vein strongly sinuate, first forking at the end of the proximal third of the tegmina, the branches longitudinally sinuate, very few in number but mostly deeply forked or compound. Internomedian vein gently and broadly sinuate, terminating not far below the apex of the tegmina, in its apical third subparallel to the margin, its five or six branches simple or forked, exceedingly oblique or longitudinally oblique. Anal furrow with exceptionally slight and regular arcuation, impressed very sharply and very deeply indeed, terminating before the end of the proximal two-fifths of the tegmina; anal area exceptionally slender for its length, the veins few, simple and arcuate. Surface uniformly black, with signs of very feeble and close, often oblique, cross lining in the interspaces.

Length of tegmina, 18 mm.; breadth, 5 mm.

By its elongate straight form this species is very different from every other known, and it is hardly less remarkable for the imitation of the mediastinal by the scapular vein and the late forking of the latter.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2118*a*.

52. ETOBLATTINA STIPATA.

Pl. VIII, fig. 3.

Etoblattina stipata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 52–53 (1889).

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County.

53. ETOBLATTINA PRÆDULCIS sp. nov.

Pl. VIII, fig. 12.

Tegmina lanceolate, three times as long as broad, tapering from the end of the proximal third almost as much on the inner as on the costal side, the costal margin gently and regularly arcuate, the inner nearly as much so, the apex very sharply rounded. Mediastinal area broad, tapering in nearly the distal half, terminating somewhat before the distal end of the middle third of the tegmina, the branches very oblique, nearly straight, simple or forked. Scapular vein very faintly arcuate beyond the base, terminating a little before the very apex of the tegmina, first forking at the end of the proximal third of the tegmina, with about five simple or forked, straight and long, very oblique branches. Externomedian vein feebly oblique and nearly straight beyond the base, with three longitudinal branches very distant in origin, the first arising before the first scapular fork and in the single specimen seen simple, the second arising near the middle of the tegmina and narrowly forked, the third doubly and very deeply forked. The internomedian vein is gently sinuate, though nearly straight beyond the basal arcuation, ending well before the apex of the tegmina with half a dozen moderately close, mostly simple, feebly arcuate, strongly oblique branches. Anal furrow regularly and rather strongly arcuate, moderately impressed, terminating a little beyond the end of the proximal two-fifths of the tegmina; anal veins simple, arcuate. Surface of tegmina dark brown, at least the anal and internomedian veins feebly and rather broadly margined with black, and all the interspaces crowded with straight cross lines.

Length of fragment, 17 mm.; probable length of tegmina, 21.5 mm.; breadth, 7 mm.

This species bears a certain but not a striking resemblance in its neuration to the much stouter *E. mediana,* and a close relation in form and neuration to *E. rogi;* but from this latter the different character and extent of the externomedian area, as well as the longer mediastinal at once clearly separates it. Indeed the character of the externomedian area is quite different from that of any known species. In the character of the anterior half of the tegmina it is nearly related to *E. variegata.*

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2119 *a–b.*

54. ETOBLATTINA VARIEGATA.

Pl. VIII, fig. 10.

Etoblattina variegata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 51–52 (1889).

Two additional specimens of this species have been found in the original locality by Mr. Huston.

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County.

55. ETOBLATTINA HILLIANA sp. nov.

Pl. VIII, fig. 11.

Tegmina oval, almost three times as long as broad, the costal margin strongly and regularly arcuate, the apex probably well rounded. Mediastinal area vittate, the vein straight nearly to the tip, which reaches the distal end of the middle fifth of the tegmina, the veins rather numerous, simple or forked, and less oblique than common. Externomedian vein broadly sinuate, much more strongly arcuate at base than apically, terminating not far before the apex of the tegmina, first forking at the end of the proximal third of the tegmina, with four or five strongly oblique, arcuate, simple, forked or multiple-forked branches. Externomedian vein very strongly sinuate in the middle of the tegmina, where the branches are thrown off straight and oblique, first branching a very little beyond the first scapular fork, with about five rather straight, longitudinal, simple, simply forked or doubly forked branches. Internomedian vein gently arcuate beyond the base, probably ending about the middle of the distal half of the tegmina, the earlier branches crowded, straight, simple, and oblique, the later more oblique, arcuate, and deeply forked. Anal furrow probably strongly arcuate and terminating not far from the end of the proximal third of the tegmina. Surface uniform, with scarcely the least sign of any cross lining.

Besides the larger part of two tegmina there is preserved a fragment of a pronotal shield which was probably of transverse oval form, much more strongly rounded in front than behind, broadest close to the posterior margin, and probably nearly half as broad again as long; its edge appears very delicately margined.

Length of entire fragment, 30 mm.; probable length of tegmina, 27.25 mm.; breadth, 9.5 mm.

This species is named after Mr. Homer D. Hill, of Morris, Ill., at the suggestion of Mr. Lacoe. Mr. Hill has been very persevering and successful in the search for fossil insects at Mazon Creek.

It does not seem to be very nearly related to any of our American species, but perhaps bears closer resemblance to *E. mazona* than to others; it shows some relation to the European *E. russoma.*

From the Lowest Productive Coal-measures of Mazon Creek, Morris, Grundy County, Ill. Mr. R. D. Lacoe; one specimen, No. 2070 *a–b.*

56. ETOBLATTINA ANGUSTA sp. nov.

Pl. VIII, fig. 8.

Tegmina very slender, two and a quarter times longer than broad, nearly parallel-sided in the middle third, tapering slowly beyond, the apex probably well rounded, the costal margin strongly convex only at base, the inner margin probably straight. Mediastinal area vittate but tapering constantly from the middle, the apex acuminate and reaching past the distal end of the middle third of the tegmina, the nearly straight simple branches of the vein changing from oblique to very oblique distally. Scapular vein straight or arcuate to its first fork (at the end of the proximal third of the tegmina), there bent and thereafter very broadly arcuate, in the middle as well as the proximal third of the tegmina subparallel to the costal margin, terminating scarcely before the very apex of the tegmina; there are about five long, nearly straight, simple or deeply forked branches. The externomedian vein is arcuate pretty regularly throughout, first forks opposite the first scapular fork, and has three or four longitudinal, gently arcuate, simple or forked branches. The internomedian vein is similarly arcuate, the area apically regularly attenuate, terminating but a little beyond the mediastinal vein at the distal end of the middle third of the tegmina, with four distant, straight, simple, strongly oblique branches. Anal furrow sharply impressed, terminating not far from the end of the proximal third of the tegmina. Surface blackish brown, the veins all edged rather broadly and indistinctly with black, the interspaces filled with crowded, straight, uniform cross lines.

Length of fragment, 13 mm.; probable length of tegmina, 16.5 mm.; breadth, 5 mm.

In the distribution of the neuration this species reminds one of the very much broader *E. funeraria*, but it differs in detail at every point.

It also resembles *E. hilliana* in a similar way. It is remarkable for the slenderness of the internomedian area, which is indeed hardly broader than the mediastinal.

From the Waynesburg coal (Upper Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2080 *a–b*.

57. ETOBLATTINA MACILENTA sp. nov.

Pl. VIII, fig. 9.

Tegmina scarcely less than three times as long as broad, ovate, tapering from well beyond the middle, the costal margin strongly convex at base, but beyond very faintly arcuate, not more so than (if as much as) the inner margin, the apex probably strongly rounded. Mediastinal area apically acuminate, reaching nearly to the distal end of the middle third of the tegmina, the branches of the vein straight, simple, very oblique. Scapular vein gently sinuate, terminating scarcely short of the extreme apex of the tegmina, first forking at about the end of the proximal third of the tegmina, with about four longitudinally oblique branches, the first doubly forked, the others simple and nearly straight. Externomedian vein nearly straight beyond the arcuate base, first forking somewhat, though not greatly, beyond the scapular vein, with about three longitudinal simple or deeply forked branches. Internomedian vein straight beyond the basal arcuation, terminating about the middle of the distal two-fifths of the tegmina, with straight, simple or forked, oblique branches. Anal furrow terminating not far from the end of the basal third of the tegmina, pretty regularly and strongly arcuate, situated at the depth of a depression; anal veins simple or occasionally deeply forked, arcuate, crowded. Surface uniformly black, with feeble signs of rather distinct straight cross lining in the interspaces.

Length of two fragments in juxtaposition, 10 mm.; probable length of tegmina, 12.25 mm.; breadth, 4.25 mm.

This species appears to be more closely allied to *E. angusta* than to any other, but differs much from it, not only in form but in the character of the externomedian and the width of the longer internomedian area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va., Mr. R. D. Lacoe; one specimen, No. 2121 *a–b*.

58. ETOBLATTINA EXILIS.

Pl. IX, fig. 1.

Etoblattina exilis Scudd., Bull. U. S. Geol. Surv., No. 101, 17, pl. 2, fig. *e* (1893).

From the Lower (?) Productive Coal-measures of East Providence, R. I.

59. Etoblattina rogi sp. nov.

Pl. IX, figs. 2, 3.

Unfortunately the basal third or more is lost fro
mens of this evidently distinct species, and the precis
tions are necessarily conjectural, but the main featur
are preserved. The tegmina are evidently almost o
as long as broad, lanceolate, with almost equally a
costal and inner margins, the apex subacuminate b
mediastinal area is broad and tapers regularly in th
ing not far from the distal end of the middle fifth o
branches of the vein long, simple, straight, exceedingl
lar vein very gently arcuate, terminating only a little
apex of the tegmina, first forking near the end of th
the tegmina, the branches simple, very deeply for
longitudinally oblique. Externomedian vein beyon
tion straight and oblique, first forking not far from
fork, with four or five straight, longitudinal, simple o
ally doubly forked, apically arcuate branches. Inter
the preceding, terminating not far from the middle o
the tegmina, the branches mostly simple, straight, ex
Anal furrow ending just within the end of the pro
the tegmina. Surface blackish-brown, the veins bl
edged with black, the interspaces filled with distinct
straight cross lines.

Length of fragments, 12 to 15 mm.; probable le
18 to 20.75 mm.; breadth, 6.5 to 7.25 mm.

This species shows a certain resemblance to the
E. prædulcis, but has a shorter internomedian area a
externomedian area. In one specimen the scapular
little before, in the other a little after, the internome

From the Waynesburg coal (Lower Permian) of
Mr. R. D. Lacoe; two specimens, Nos. 2122 *a*, *b–c*, b
probably belonging here.

60. Etoblattina expugnata sp. n

Pl. IX, fig. 4.

Tegmina subovate, tapering from the middle, a ve
three times as long as broad, the costal margin ra
rather regularly arcuate, the inner margin nearly s
well rounded. Mediastinal area vittate, moderatel
only near tip, which reaches fully to the end of the m
tegmina, the branches of the vein not very frequent
and oblique, the distal branches very oblique indee
arcuate, terminating just short of the extreme ape

the branches, four in number, arcuate, longitudinally oblique, and simple or deeply forked. Externomedian vein arcuate, more strongly basally than apically, first forking just after the scapular, with four nearly straight, simple or deeply or apically forked branches. Internomedian vein gently sinuate, terminating not long before the apex, but before the scapular vein, the branches distant, gently sinuate, mostly simple, oblique, and apically very oblique. Anal furrow regularly and strongly arcuate, very deeply and sharply impressed, especially in the basal half, terminating at about the end of the proximal two-fifths of the tegmina; anal area vaulted, prominently so at the upper base, the veins mostly simple, occasionally deeply forked, more or less arcuate. Surface uniformly black, the interspaces with crowded, straight cross lines.

Length of tegmina, 18.25 mm.; breadth, 6.5 mm.

Except in its much longer mediastinal area, this species closely resembles *E. communis;* its narrower form and less arcuate internomedian vein separate it from *E. mactata*, to which in its general neuration it is nearly allied; and it bears a great deal of resemblance to *E. secreta*, but has a shorter and broader internomedian area and different development of the mediastinal area; it differs similarly from the next species, *E. obatra*, to which it is very closely allied, but has a longer and slenderer anal area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2085 *a–b*.

61. ETOBLATTINA OBATRA sp. nov.

Pl. IX, fig. 5.

Tegmina subovate, slightly more than three times as long as broad, broadest just before the middle, the costal margin considerably arcuate but less so in the middle half, the inner margin straight, the apex well rounded. Mediastinal area vittate, tapering in the apical third, reaching nearly to the distal end of the middle third of the tegmina, the branches of the vein mostly simple, arcuate, and excessively oblique. Scapular vein beyond the basal arcuation faintly arcuate, terminating just before the apex of the tegmina, first forking considerably within the proximal third of the tegmina, with about four deeply forked or simple, arcuate, longitudinally oblique branches. Externomedian vein beyond the probably strong basal arcuation nearly straight and oblique, first forking about opposite the end of the anal furrow, with three longitudinal or nearly longitudinal, apically forked or deeply doubly forked, nearly straight branches. Internomedian vein sinuate, being slightly arcuate at base, faintly arcuate at tip, ending not a great way before the apex of the tegmina at the edge of the apical border, the infrequent branches straight, the proximal oblique, the distal excessively oblique, and both simple or forked. Anal furrow strongly arcuate, sharply impressed, terminating a little short of the end of the proximal two-fifths of the tegmina; anal veins arcuate and numerous. Surface uniformly black, with faint, moderately close cross lines in the interspaces.

Length of tegmina, 17 mm.; breadth, 5.25 mm.

In the general direction of the veins and extent of the areas this species shows a great resemblance to *E. exsecuta*, but the tegmina are much slenderer, the mediastinal branches far more oblique, and the externomedian neuration simpler. It bears almost a greater resemblance, both in venation and in the form of the tegmina, to *Gerablattina concinna*, but the mediastinal area is much shorter. From the preceding species, *E. expugnata*, to which it is closely allied, it differs in form, in the crowding and obliquity of the mediastinal branches, and in the more abbreviated and relatively broader anal area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2123 *a–b*.

62. ETOBLATTINA IMPERFECTA sp. nov.

Pl. IX, fig. 8.

Tegmina ovate, three times as long as broad, tapering only on the apical third, the middle portion equal, the costal margin gently arcuate, the inner margin straight beyond the considerable arcuation of the anal area, the apex probably well rounded. Mediastinal area moderately narrow, vittate, tapering in less than the distal third, terminating but little before the middle of the distal half of the tegmina, the branches of the vein mostly deeply forked, exceedingly oblique and arcuate. Scapular vein gently and pretty uniformly sinuate, terminating just above the apex of the tegmina, first forking opposite the tip of the anal furrow, with about four gently arcuate, deeply forked or simple, longitudinally oblique branches. Externomedian vein gently sinuate, first forking opposite the scapular, and with but this single straight and deeply forked, perhaps compound, longitudinal branch. Internomedian vein arcuate, but nearly straight in the apical half, terminating but little before the very apex of the tegmina, as near it as the scapular vein; the branches are distant, the proximal simple and oblique, the distal forked or doubly forked, very oblique and gently arcuate. Anal furrow strongly arcuate, deeply impressed in basal half, and terminating at the end of the proximal two-fifths of the tegmina; anal veins few, arcuate, simple. Surface uniformly black, the interspaces with excessively faint, close, and straight cross lining.

Length of fragment, 12.5 mm.; probable length of tegmina, 16.5 mm.; breadth, 5.5 mm.

In the general features of its neuration this species agrees at all points with *E. obatra*, but the internomedian area is slightly longer, the externomedian area of much less importance, the costal margin not so convex and the anal area distinctly fuller. In the forking and greater longitudinality of the mediastinal branches and the paucity of the externomedian neuration it is distinctly different from *E. secreta* that follows.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2124 *a–b*.

63. ETOBLATTINA SECRETA sp. nov.

Pl. IX, figs. 6, 7.

Tegmina about three times as long as broad, ovate, broadest in the middle, but sometimes not tapering for some distance beyond, with rather strongly arcuate costal margin and straight inner margin, the apex probably well rounded. Mediastinal area vittate, not very broad, apically acuminate, reaching to about the distal end of the middle third of the tegmina, the branches of the vein not numerous, very oblique, sometimes exceedingly oblique, mostly simple. Scapular vein more or less sinuate, terminating just before the very apex, first forking at about the end of the proximal end of the tegmina, with five or six arcuate, mostly simple, sometimes deeply forked, exceedingly oblique branches. Externomedian vein sinuate, much more strongly arcuate at base than apically, first forking well beyond the scapular and not far from a point opposite the tip of the anal furrow, the three or four branches nearly straight and longitudinal, simple and deeply forked or occasionally doubly forked. Internomedian vein similar to the externomedian or slightly less sinuous, ending before the apex but reaching almost as far as the scapular, the branches rather distant, the first and sometimes the last deeply forked, the others mostly simple, straight or faintly arcuate, very oblique. or apically exceedingly oblique. Anal furrow not very strongly arcuate, well impressed, terminating at about the end of the proximal two-fifths of the tegmina; anal area vaulted, especially next the basal half of the furrow, the branches relatively few and arcuate. Surface uniformly black, with rather crowded straight cross lines in the interspaces.

Length of fragment, 15 to 15.5 mm.; probable length of tegmina, 18.5 to 19 mm.; breadth, 6.25 to 6.5 mm.

This species is closely allied to *E. imperfecta*, from which it differs principally in the distance from the base at which the scapular and externomedian veins first fork, in the general character of the externomedian vein, and in the less crowded branching of the mediastinal vein. Similar differences separate it from *E. obatra*, while the slenderer mediastinal area and greater extension of the internomedian area distinguish it from *E. expugnata*. It is also nearly allied to *E. exsecuta*, but in that species the scapular and externomedian veins first fork side by side, and in the broader anal area the veins are more crowded. Its greater slenderness separates it from *E. communis*, with which it agrees almost completely in its neuration; the mediastinal area, however, is distinctly longer than in that species.

The two specimens figured differ considerably from each other in the form of the tegmina, the obliquity of the mediastinal branches, and the sinuosity of the scapular vein, but I am inclined to think they should be regarded as belonging to one species.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; four specimens, Nos. 2125 *a–b*, *c–d*, *e–f*, *g*, besides another presumably to be referred here.

64. ETOBLATTINA RELIQUA.

Pl. IX, fig. 10.

Etoblattina reliqua Scudd., Bull. U. S. Geol. Surv., No. 101, 18–19, pl. 2, fig. *g* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

65. ETOBLATTINA INVISA sp. nov.

Pl. IX, fig. 9.

Tegmina about three times as long as broad, ovate, largest a little before the middle, but with nearly parallel sides, the costal margin and inner margin equally and very gently arcuate in the middle two-thirds, the humeral angle probably strongly rounded, the apex well rounded. Mediastinal area moderately broad, vittate, rather rapidly tapering apically and reaching beyond the distal end of the middle third of the tegmina, the vein with few, oblique, simple branches. Scapular vein beyond the basal arcuation almost rigidly straight and terminating just short of the very apex of the tegmina; it first forks at the middle of the tegmina and has about five simple branches, like those of the mediastinal area. The externomedian vein, straight in its middle course, is broadly sinuate, first forking a little before the end of the mediastinal vein, and has three arcuate, apically longitudinal, simple, distant branches. The internomedian vein is broadly sinuate and terminates at some distance before the apex, the few branches distant, a little arcuate, the first probably deeply forked, the others simple. Anal furrow very elongate, but little arcuate and not greatly impressed, terminating beyond the proximal two-fifths of the tegmina. Surface gray, the veins all marked and broadly margined with black, in which margin only are seen straight and crowded cross lines in its interspaces.

Length of fragment, 16 mm.; probable length of tegmina, 17.5 mm.; breadth, 6 mm.

This species seems to be very different from the other open-veined Etoblattinæ, particularly in the late forking and unimportant character of the externomedian vein, carried to excess in *E. strigosa;* it has a certain general resemblance to *E. ramosa*, but has a far more simple neuration, in which hardly a branch is forked.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2126 *a–b*.

66. ETOBLATTINA OCCULTA sp. nov.

Pl. IX, fig. 13.

Tegmina nearly parallel sided, oval, about three times as long as broad, the larger part of the costal margin very gently arcuate, the inner margin nearly straight, the apex probably well rounded. Mediastinal area narrow, vittate, tapering only apically, reaching to the middle of the distal half of the tegmina, the branches of the vein tolerably numerous, gently arcuate, oblique or very oblique, almost invariably simple. Scapular vein arcuate at base, beyond the first fork (at the end of the proximal third of the tegmina) having a general straight course and ending a little way before the apex of the tegmina, the first branch arising far before the others, the others, four or five in number, subequidistant, simple or forked, arcuate and exceedingly oblique. Externomedian vein gently sinuate, first forking well beyond the scapular, the three or four branches distant, longitudinally oblique and simple or forked or perhaps compound. Internomedian vein strongly sinuate, especially basally, terminating a little way before the apex, probably as far or nearly as far as the scapular vein, the latter half of the area slender, the proximal half with very distant, oblique, arcuate, mostly simple branches. Anal furrow strongly arcuate, strongly impressed, terminating a little within the end of the proximal two-fifths of the tegmina; anal area slightly vaulted, the veins in the portion next the furrow distant and strongly arcuate, those distant from it crowded, gently and oppositely arcuate, all simple. Surface carbonaceous black with elongate gray patches between the veins, or it may be described as gray with very broad black margins to all the veins, often confluent, especially at the ends of the interspaces; the black portion is traversed by rather crowded straight cross lines.

Length of fragment, 17 mm.; probable length of tegmina, 26 mm.; breadth, 9 mm.

This species is somewhat related to *E. balteata*, but differs in its form and the particular character of each of the areas. From the next species, *E. defossa*, it differs particularly in the very different formation of the externomedian vein. The neuration is strikingly similar to that of *Gerablattina diversinervis*, and the great length of the mediastinal vein makes it closely resemble a Gerablattina; it seems, however, to belong better here.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2127 *a–b*.

67. ETOBLATTINA LATEBRICOLA sp. nov.

Pl. IX, fig. 11.

Tegmina nearly three times as long as broad, ovate lanceolate, with unusually subacuminate apex, the costal margin gently arcuate beyond the strongly rounded humeral curve, the inner margin gently arcuate beyond the anal furrow, the anal margin gently arcuate independently. Mediastinal area vittate, moderately narrow, tapering only beyond the middle of the tegmina, reaching nearly to the middle of the distal half of the tegmina, the branches of the vein oblique or very oblique, simple or apically forked. Scapular vein very gently and broadly sinuate, terminating but little before the very apex of the tegmina, first forking a little beyond the proximal third of the tegmina, the three equidistant branches considerably arcuate, longitudinally oblique, deeply and simply or doubly forked. Externomedian vein arcuate, first forking just beyond the scapular vein, the four or five branches longitudinal and straight, simple or deeply forked or compound, both the scapular and externomedian branches being very crowded in the apical fourth of the tegmina. Internomedian vein very gently arcuate, the area apically extended slightly so as to terminate almost as near the apex as the scapular vein, the branches distant, the proximal nearly straight, simple and very oblique, the distal more oblique and mostly forked. Anal furrow not very strongly but uniformly arcuate, somewhat strongly impressed, terminating a little before the end of the proximal two-fifths of the tegmina; anal area strongly vaulted next the furrow, the veins simple and arcuate. Surface black, with straight rather crowded cross lines on either side of the main veins in the central portions of the tegmina but not crossing the interspaces.

Length of tegmina, 17.5 mm.; breadth, 6 mm.

From the Lower (?) Productive Coal-measures of East Providence, R. I. Mr. R. D. Lacoe; one specimen, No. 2091 *a–b*.

68. ETOBLATTINA DEFOSSA sp. nov.

Pl. IX, fig. 12.

Tegmina elongate, probably more than three times as long as broad, ovate, the costal margin gently arcuate, the inner less so, the apex probably well rounded. Mediastinal area long and moderately wide, apically acuminate, reaching nearly or quite to the middle of the distal half of the tegmina, the branches of the vein distant, mostly simple and very oblique. Scapular vein nearly straight, apically faintly arcuate, terminating a little before the apex, the first branch arising far before the others, and all, four in number, simple or deeply or doubly forked, arcuate and longitudinally oblique. Externomedian vein first forking well before the middle of the tegmina and probably not far from the first scapular forking, this first externomedian fork and the main vein parting like a longitudinal narrow fork and each fork very deeply forked, sometimes with a secondary deep fork, all longitudinal and sometimes arcuate. Internomedian vein in the apical half of its course subparallel to the inner border and, by means of a superior supplementary, deeply forked, arcuate, superior branch, extending the area nearly to the apex of the tegmina, the other branches distant, simple, arcuate, strongly oblique. Surface black, the interspaces with crowded, irregular, tremulous cross lines, forming in places almost an irregular reticulation.

Length of fragment, 14.5 mm.; probable length of tegmina, 28.75 mm.; breadth, 8.5 mm.

This species is closely allied to the preceding, but is apparently slenderer, and differs from it in many important features, and especially in the character of the externomedian vein. In this last characteristic it more nearly resembles *E. tenuis*, but in the character of the upper part of the tegmina it is very different from it.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2128 *a–b*.

69. ETOBLATTINA RECIDIVA sp. nov.

Pl. IX, fig. 14.

Tegmina probably about three times as long as broad, lanceolate, the costal margin gently convex, the inner nearly straight, the apex subacuminate, but well rounded. Mediastinal area terminating somewhat short of the distal end of the middle third of the tegmina, the branches of the vein very oblique and simple. Scapular vein very straight, terminating but little short of the apex, the first branch arising far before the others, rather deeply forked and bent at the fork; the others like this fork straight, very oblique indeed, and simple or forked. Externomedian vein probably nearly straight throughout and longitudinally oblique, first forking probably beyond the scapular and about at the end of the proximal third of the tegmina, the four or five branches straight, longitudinal and simple or forked. Internomedian vein beyond the basal curve nearly straight, but as a whole sinuate, terminating not much beyond the middle of the distal third of the tegmina, the branches rather distant, simple, arcuate, and oblique, or very oblique. Surface black, traversed by delicate, irregular and tremulous, crowded cross lines in all the interspaces.

Length of fragment, 8 mm.; probable length of tegmina, 19.5 mm.; breadth, 6.25 mm.

This species is perhaps as nearly allied to *E. hastata* as to any other of our species, but is very different indeed from it.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2129*a*.

ETOBLATTINA sp.

Pl. X, figs. 14, 15.

A single specimen with its reverse shows an unusually complete and excellently preserved hind wing, which must be referred to this genus. The wing is subovate, subacuminate at tip, with very gently arcuate costal and inner margins. The mediastinal vein runs parallel and close to the costal margin, with a few strongly oblique branches in an apical cluster, and a subbasal branch which runs between the main vein and the margin and is lost. The scapular vein is very straight, running to scarcely below the extreme apex of the wing, first branches a little before the middle of its course, and has four simple, forked, longitudinal branches. The externomedian vein is similarly straight, a little divergent from the scapular vein, first branches a little earlier than it, and has three long, simple, almost longitudinal branches. The internomedian vein is rigidly straight, and ends slightly further out than the mediastinal vein, with five parallel, straight, mostly simple or oblique branches. The anal furrow seems to differ from the other anal veins in there being a step in the membrane at this point, the vein itself, like the other anal veins, being more delicate than the internomedian branches next it and less deeply impressed; most of it can be traced, and, except for the points mentioned, it appears quite as a branch of the internomedian, being straight, except for an apical sinuation, and parallel to the intermomedian branches; the other anal veins, of which only the apical halves appear, are similar in delicacy and direction, but gradually become more crowded, as is usual in the tegmina, and slightly arcuate; the furrow ends on the inner margin, slightly beyond a point opposite the first forking of the scapular vein. Surface uniformly blackish, the interspaces, at least near the apical margin, filled with not very close, straight but irregular cross lines.

Length of fragment, 10.5 mm.; probable length of wing, 14.5 mm.; breadth, 6.5 mm.

This is the only hind wing of an Etoblattina known to me in which any part of the anal area is preserved.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2084 *a–b*.

ETOBLATTINA sp.

Pl. XII, fig. 2.

Etoblattina sp. Scudd., Bull. U. S. Geol. Surv. No. 101, 13–14, pl. 2, fig. *c* (1893).

In the paper quoted I regarded this as a fragment of a fore wing from near the middle, somewhat allied to *E. primæva*. A renewed study shows that the costal curve is a natural one and that the fragment is rather the apical portion (with part of the tip lost) of a hind wing, in

possibly, the tip of the internomedian vein is included. It
s to belong to Etoblattina, but its special relations are inde-
ble.

the Lower (?) Productive Coal-measures of East Providence,

ETOBLATTINA (?) sp.

Pl. XII, fig. 4.

a sp. Scudd., Bull. U. S. Geol. Surv. No. 101, p. 16, pl. 2, fig. *k* (1893).

rther remarks on this hind wing see p. 29.

the Lower (?) Productive Coal-measures of Cranston, R. I.

10. Genus GERABLATTINA.

na Scudd., Mem. Bost. Soc. Nat. Hist., III, 97–98 (1879); Foss. Ins. N. A.,
–118 (1890).

to Etoblattina, from which this genus is but slightly differenti-
rablattina is the prevailing type of Palæoblattariæ, at least in
ntry. It appears first in the Millstone Grit—a single species in
nsylvania coal field—and it extends to the Permian, where it
tes, but it has not been recognized, like Etoblattina, in the Trias.
three-quarters of the twenty-one species of this country come
Permian, and, indeed, from the single locality at Cassville,
three from the Barren Coal-measures of Ohio, and the remain-
from the Oldest Productive Coal-measures of Rhode Island.
nce from all Western deposits is a little curious.

rope its standing is disputed by Anthracoblattina, which there
exceptional importance. The ten species found there enjoy
he same geologic range as here and the same as Anthracoblat-
rmatoblattina, and Etoblattina in Europe, namely, from the
Productive Coal-measures to the Permian, inclusive, culminat-
arently, in the Upper Carboniferous deposits.

Table of the species of Gerablattina.

main veins independent from or almost from the base.
ina relatively slender, considerably more than twice as long as broad.
diastinal area very narrow, in its middle at most hardly more than one-fifth the width of the tegmina; internomedian branches relatively distant.
nal area relatively long; scapular vein first branching opposite or before the extremity of the anal area.
First internomedian branch very oblique, thrown off far before the end of the anal area.............................. 1. *G. inculta.*
First internomedian branch nearly transverse, thrown off scarcely before the end of the anal area.......................... 2. *G. perita.*
nal area[1] relatively short; scapular vein first branching far beyond the extremity of the anal area.

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[1] This point not known in *G. apicalis.*

Table of the species of Gerablattina—Continued.

e^1. Scapular area reaching the extreme apex of the tegmina.. 3. *G. apicalis.*

e^2. Scapular area not reaching the extreme apex of the tegmina.

f^1. Scapular vein first forking far before the middle of the tegmina, less abundantly branched than the externomedian. 4. *G. diversinervis.*

f^2. Scapular vein first forking but little before the middle of the tegmina, and more abundantly branched than the externomedian. 5. *G. richmondiana.*

c^2. Mediastinal area relatively broad, in its middle at least a fourth the width of the tegmina; internomedian branches relatively close.

d^1. All the mediastinal branches simple, or simply forked.[1]

e^1. Internomedian area long drawn out, extending at least as far as, generally much farther than, the mediastinal area.

f^1. Internomedian area reaching, or almost reaching, the extreme tip of the tegmina.

g^1. Internomedian area band shaped, tapering but little, the branches numerous and relatively short.................... 6. *G. cassvici.*

g^2. Internomedian area triangular, tapering much, the branches few and relatively long.................................. 7. *G. abdicata.*

f^2. Internomedian area falling distinctly, often considerably, short of the extreme tip of the tegmina.

g^1. Scapular and externomedian areas about equally important, each throwing at least half a dozen veins to the margin.

h^1. Tegmina very slender, fully three times as long as broad. 8. *G. concinna.*

h^2. Tegmina less slender, not more than two and a half times longer than broad................................. 9. *G. uniformis.*

g^2. Scapular and externomedian areas very unequally important, one or the other with at most three or four veins on the margin.

h^1. Anal area long, nearly reaching the middle of the tegmina; externomedian area unimportant................. 10. *G. permanenta.*

h^2. Anal area short, about one-third the length of the tegmina, scapular area unimportant........................... 11. *G. permacra.*

e^2. Internomedian area rapidly tapering, barely or not reaching the middle of the distal half of the tegmina.

f^1. Anal area short and broad; general course of the scapular branches arcuate in a sense opposite to that of the anal furrow. 12. *G. eversa.*

f^2. Anal area long and narrow; general course of the scapular branches longitudinal and straight .... 13. *G. deducta.*

d^2. Very nearly all the mediastinal branches forked and some of them compound.

e^1. Tegmina more than 40 mm. long; internomedian and mediastinal areas of very unequal length; scapular and externomedian areas of nearly equal importance; scapular branches only very slightly arcuate .... 14. *G. scapularis.*

e^2. Tegmina less than 20 mm. long; internomedian and mediastinal areas of equal length; scapular and externomedian areas of distinctly unequal importance; scapular branches considerably arcuate. 15. *G. fraterna.*

b^2. Tegmina relatively stout, but little or not more than twice as long as broad.

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[1] In *G. abdicata* only are they sometimes doubly forked at extreme tip.

Table of the species of Gerablattina—Continued.

- c^1. Scapular area important, first forking in basal half of tegmina, with half a dozen branches on margin.
  - d^1. Main scapular vein striking the margin below the apex of the tegmina. 16. *G. radiata.*
  - d^2. Main scapular vein striking the margin at the apex of the tegmina.
    - e^1. Tegmina subequal in breadth, broadly rounded at apex; main externomedian and internomedian veins sinuous.
      - f^1. Mediastinal area subequal throughout, the main vein sinuous. 17. *G. lata.*
      - f^2. Mediastinal area narrowing throughout, the main vein straight. 18. *G. rotundata.*
    - e^2. Tegmina greatly tapering in distal half, the apex subacuminate; main externomedian and internomedian veins straight beyond the arcuate base.. 19. *G. ovata.*
- c^2. Scapular area unimportant, first branching far beyond the middle of the tegmina and with only three or four branches on margin. 20. *G. minima.*

a^2. Externomedian and internomediam veins joined with the scapular in the basal sixth of the tegmina.......................... 21. *G. fascigera.*

1. GERABLATTINA INCULTA sp. nov.

Pl. IX, fig. 16.

A single fore wing, not very well preserved and with the apical third lost, is all that represents this species. It is long obovate in form, nearly equal in breadth, except at the extreme end, largest in the middle, and probably about two and a half times longer than broad. The mediastinal area probably extended to the middle of the distal half of the wing, and is very narrow and equal, hardly more than a fifth the breadth of the wing; the branches of the vein are five or six in number, mostly thrown off from the proximal half of the vein, simple or simply forked and exceptionally longitudinal. The scapular vein recedes slightly from the margin in passing down the tegmina, and probably terminates at the apex; it has only two or three straight, longitudinal, sometimes very deeply forked offshoots from its only superior branch, which is thrown off at about the middle of the proximal half of the tegmina. The externomedian vein is a reversed repetition of the scapular, but branches at the middle of the tegmina only. The internomedian vein is very gently arcuate, first branches about as early as the scapular vein, has only four or five gently arcuate or straight simple branches, and extends as far as the mediastinal vein. The anal furrow is impressed moderately in only its proximal half, is bent slightly in the middle and otherwise considerably arcuate, terminating at the middle of the tegmina; the anal veins, seven or eight in number, are subparallel, successively more distant and more arcuate toward the anal furrow, and most of them simple. The surface of the tegmina is black and marked with exceedingly close cross lines at right angles to the veins they connect.

Length of fragment, 11.25 mm.; probable length of tegmina, 14.6 mm.; breadth, 6.6 mm.

The single specimen is from the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, No. 2139*a*.

2. GERABLATTINA PERITA sp. nov.

Pl. IX, fig. 17.

The tegmina, of which only the basal portion of one is preserved, are apparently of an elongate and nearly equal form, to judge from the form of the base and the general course of the branches; certainly it must have been considerably more than twice as long as broad. The mediastinal area is exceedingly narrow, riband-like, but its exact extension can not of course be told; the vein runs parallel to the margin throughout its course, and in the middle of the wing can not occupy more than a fifth the width of the tegmina; the branches are rather distantly oblique, rather strongly arcuate, and simple. The scapular vein first forks at about opposite the tip of the anal furrow, the fork diverging somewhat strongly from the main branch, and neither the main stem nor the branch forks again in the fragment, or probably before the middle of the wing. The externomedian vein is rather strongly arcuate in the basal half of the tegmina, where it is entirely simple and is somewhat widely distant from the scapular vein. The internomedian vein is similarly or a little more strongly arcuate, diverging slightly from the externomedian before it begins to branch; it begins to throw off branches opposite the first forking of the scapular, and the two forks which are preserved in the fragment are somewhat distant and obliquely transverse. The anal area is but very slightly vaulted, the furrow strongly arcuate, terminating evidently at some distance before the middle of the tegmina; the veins are arcuate in the same sense, simple, and more and more crowded away from the anal furrow. The entire surface is traversed by finely incised, closely approximate, tremulous cross lines, and all the main veins and their main branches are broadly banded with piceous, leaving between them and along the outer edge of the main mediastinal vein (independent of its nervules) narrow colorless stripes.

Length of fragment, 9.5 mm.; probable length of tegmina, 17.5 mm.; width at extremity of anal furrow, 5.25 mm.

The single specimen and its reverse from the Waynesburg coal (Lower Permian) of Cassville, W. Va., are in the collection of Mr. R. D. Lacoe, under the number 2140 *a–b*.

3. GERABLATTINA APICALIS sp. nov.

Pl. IX, fig. 18.

Only the apical half, more or less, of one of the tegmina is preserved, so that the proportions of the same can not be definitely determined, but it was apparently of nearly the same proportions as the following species. The mediastinal area is not preserved in any portion of its course, unless it be by the veins which are seen a little before the tip of the tegmina, but whose origin is lost. This would appear to be entirely uncertain, though it would seem as if the basal one belonged to this area, which would then correspond very closely in its extent with the following species; but in that case, to judge by the course of the scapular veins, the width of the mediastinal area must have been fully as great as there, if not greater. The scapular area, however, was of extraordinary extent, the main vein running in the apical half of the tegmina parallel to and at a great distance from the front margin and terminating exactly at the apex of the tegmina, throwing off in the apical portion three simple or deeply forked branches, having each a longitudinal course, and with no such sinuous curvature as is found in the next species. The main externomedian vein in the apical half of the tegmina runs again parallel to and at a wide distance from the scapular vein, terminating on the inner margin and sending to the apical portion of the same three simple, rather distant branches, the first of which is forked just before its tip; in the apical portion of its course the externomedian vein diverges slightly from the scapular and approaches apically the internomedian vein. This latter terminates on the apical half of the outer border, apparently very much in the same way as in *G. diversinervis*, the area appearing apically to be very much narrowed and possessing only simple, very distant and oblique branches; in the apical portion of its course the vein takes on a more longitudinal direction and thus approaches more closely to the externomedian vein, leaving between the two a constantly narrowing interspace much after the fashion of Spiloblattina. The entire surface of the fragment is black, excepting for dashes of the dark-gray color of the stone in the interspaces.

Length of fragment, 10.5 mm.; probable length of the tegmina, 20 mm.; apparent breadth near the middle of the tegmina, 8 mm.

Richmond, Ohio, from the Lower Barren Coal-measures, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, collected by Mr. S. Huston; No. 112.

4. GERABLATTINA DIVERSINERVIS sp. nov.

Pl. IX, fig. 15.

A single specimen of the tegmina with its reverse, showing the nearly complete wing, the apical portion only wanting, represents a species having a very elegant form, apparently nearly three times as long as broad, with the inner margin straight, the costal margin rather strongly and equally convex. The mediastinal area is riband-shaped and extends to the exact tip of the fragment or probably to well beyond the middle of the apical half of the wing; the area is narrow, in its middle hardly more than a fifth the width of the tegmina, the vein with oblique and increasingly oblique, simple, scarcely arcuate branches, numerous and subequidistant. The main scapular and externomedian veins are somewhat widely distant from each other and from the veins on either side of them in the middle of the tegmina; the scapular is gently sinuous throughout its course, begins to fork a little beyond the basal third of the tegmina, and has four at origin strongly inequidistant, closely crowded, simple or simply forked branches, apically upcurved toward the margin of the tegmina and here no more distant from each other than the mediastinal branches; the outermost carry the scapular area only half way from the mediastinal area to the apex of the tegmina. The externomedian vein beyond its basal curvature is nearly straight throughout the greater portion of its course and emits three rather distant and at their origin widely distant, straight and longitudinal branches, simple or forked. The internomedian vain is gently sinuous throughout its course, rapidly narrows beyond its base, and extends to at least as far as, probably slightly farther than, the mediastinal area, and is furnished with seven or eight widely distant, gently arcuate, obliquely transverse, apically oblique, simple branches. The anal area is scarcely vaulted, the anal furrow deeply incised, strongly arcuate, terminating hardly beyond the middle of the basal half of the tegmina; the anal veins are few, irregularly arcuate in the same sense as the anal furrow, and rather widely distant. Along the whole all the veins and branches are broadly banded, in the mediastinal area narrowly banded, with piceous, in which the membrane of the tegmina is seen to be delicately, transversely, and numerously cross veined.

Length of fragment, which is broken slightly at the base as well as at the tip, 19 mm.; probable length of the tegmina, 25 mm.; breadth, 9 mm.

This species is closely allied to *G. perita*, but markedly different from it in the narrow extent of the scapular area, which is far from reaching the extreme apex of the tegmina.

The single specimen and its reverse came from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and are in the collection of Mr. R. D. Lacoe, with the number 2141 *a–b*.

5. GERABLATTINA RICHMONDIANA sp. nov.

Pl. X, fig. 1.

This species is represented by only a single specimen, rather imperfect, but showing nearly the whole of the costal margin. The tegmina are apparently about two and one half times longer than broad, with a rather strongly and regularly arcuate costal margin; the apex is lost, but was apparently much as indicated in the figure. The mediastinal area is vittate, slightly broader than in its allies, being nearly a fourth the breadth of the tegmina in the middle, and ends a little beyond the middle of the distal half of the tegmina, the vein with rather distant, nearly straight, and strongly oblique nervules. The scapular vein is broadly sinuous, first forks only a little before the middle of the tegmina, beyond which it has numerous compound branches, the lowest of which strike the margin scarcely if at all above the extreme apex. The externomedian vein is broadly arcuate; its first visible branch arises a little beyond the middle of the tegmina, but it is here so much farther removed from the internomedian than from the scapular vein that probably an earlier branch, obscured from the imperfect preservation of the specimen, arises not far from opposite the first branch of the scapular vein; the behavior of the branches can not be seen from the imperfection of the specimen, but there is not room for the wide radiate arrangement of compound branches possessed by the scapular vein. The internomedian vein, only the proximal two-thirds of which can be traced, is broadly arcuate, and send out only a few distant, tolerably straight branches, the first of which is twice or thrice branched on the proximal side; it probably terminates about opposite the tip of the mediastinal vein. Only the merest fragment of the anal furrow can be seen, not far from the base, but it probably terminates not far from the end of the proximal third of the tegmina; none of the anal veins are preserved. There is no trace of banding or reticulation or cross lining on the surface.

Length of fragment, 20 mm.; probable length of tegmina, 25 mm.; probable breadth, 10 mm.

This species appears to be most nearly allied to *G. diversinervis*, but the tegmina are considerably stouter, with a more strongly arcuate costa, and it differs from all the preceding species, and more nearly resembles those which follow, in the greater relative width of the mediastinal area.

Lower Barren Coal-measures of Ohio, less than 100 feet above the Crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston, No. 169.

6. GERABLATTINA CASSVICI sp. nov.

Pl. X, figs. 2, 3.

This species is represented best by a nearly complete fore wing and its reverse, showing a form and proportions very similar to the preceding, the tegmina being apparently but little less than three times as long as broad, with a very strongly arcuate costal margin and a straight or nearly straight inner margin. The mediastinal area reaches well beyond the middle of the apical half of the tegmina, the main vein gradually approaching the apex during the apical half of its course, and supplied with rather numerous, strongly oblique, arcuate, and simple or forked branches. The scapular vein is very similar to that of the foregoing species, first branching well before the middle of the tegmina, and having three simple, forked, or compound branches, all of which have an upward curvature toward the costal margin, where the nervules are as closely crowded as in the mediastinal area, and the outermost of which extend the area of the scapular vein to scarcely more than half the distance from the mediastinal area to the apex of the tegmina. The externomedian vein beyond its basal curvature is nearly straight and passes with a gentle obliquity through the tegmina, subparallel to the costal margin, first forking just before the middle of the tegmina, and having in all four or five simple or simply forked, longitudinal veins, which occupy the apex of the tegmina. The internomedian vein runs in almost exact parallelism with, but at some distance from, the externomedian vein until the middle of the apical half of the tegmina, when, besides curving into a more longitudinal course, it sends from its upper margin a forked branch toward the tip of the tegmina, which it nearly reaches: the internomedian area, therefore, narrows very gradually, and has an exceedingly great extent, while the main vein has somewhat numerous, generally simple, but sometimes deeply forked, oblique, arcuate branches. The anal area is gently vaulted, the anal furrow deeply impressed, gently arcuate, and terminates but little before the middle of the tegmina; while the anal veins, similarly arcuate, are mostly simple and rather crowded, but especially so away from the anal furrow, where usually they are apically forked. In this species, too, all the veins and their branches are broadly banded with piceous, and where the veins or branches are closely approximate the banding of two or more adjoining stems may blend, and the wing is everywhere crossed in all the parts, whether piceous or otherwise, by fine, delicate, closely crowded cross lines.

Length of fragment, 21 mm.; probable length of tegmina, 25.5 mm.; breadth of same, 9 mm.

This species is closely allied to the preceding in many respects, but has a shorter, broader, and more tapering mediastinal area, much broader, more gradually tapering internomedian area, with much more crowded neuration, and which extends far nearer the apex of the tegmina.

Two specimens and their reverses have been found in the Waynesburg coal (Lower Permian) at Cassville, W. Va., and are in the collection of Mr. R. D. Lacoe, Nos. 2142 *a–b*, *c–d*.

7. GERABLATTINA ABDICATA sp. nov.

Pl. X, fig. 6.

The single specimen representing this species has lost the apical fifth of the tegmina and the anal area, but is otherwise well preserved. It is of a very regular, elongate ovate form, broadest in the middle, and somewhat less than two and one-half times as long as broad; the costal margin is very regularly and moderately convex, the inner margin very slightly convex. The mediastinal area is of normal width, and extends, decreasing in width only distally, some distance beyond the middle of the distal half of the tegmina; the vein has but five or six very longitudinally oblique and therefore long branches, simple or apically forked, sometimes doubly forked. The scapular vein is regularly and considerably arcuate, terminates just above the apex of the tegmina, first branches a little before the middle of the tegmina, and has only three or four simple, deeply forked, longitudinal, gently arcuate branches. The externomedian vein runs subparallel to the last, through the middle of the wing, first forks at about the middle, has but two or three nearly straight and simple longitudinal branches which fall upon the apical margin. The internomedian area reaches as far out as the scapular vein, is scarcely sinuous, and has only four or five long arcuate branches, the basal apically forked, the others simple. The anal furrow is gently impressed, rather strongly and pretty regularly arcuate, and terminates at the middle of the tegmina. The surface of the tegmina is blackish and is marked rather feebly by very close incised cross lines, nearly straight, but inclined to be tremulous, at right angles to the adjoining veins.

Length of the fragment, 14 mm.; probable length of tegmina, 16.5 mm.; breadth, 6.75 mm.

This species differs from *E. cassvici*, to which it is most nearly related, in the far greater breadth of the basal part of the internomedian area and in the relative unimportance and lower level of the externomedian area.

One specimen from the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, No. 2143*a*.

8. GERABLATTINA CONCINNA sp. nov.

Pl. X, figs. 4, 5.

This species is represented by a single specimen and its reverse, showing overlapping wings and tegmina, of which little can be made out, excepting the nearly complete uppermost of the tegmina, and a second specimen of an incomplete fore wing. The tegmina are very slender, slightly more than three times as long as broad, with a rather strongly arcuate costal margin, causing the tegmina to be nearly equal in their basal, somewhat rapidly tapering in their apical half, the apex falling well within the middle of the tegmina, the inner margin being straight. The mediastinal area reaches to the middle of the apical half of the tegmina, is moderately broad, tapers very regularly and uniformly in its apical half, and is filled with strongly oblique, increasingly oblique, and simple or forked, rather long branches. The scapular vein first branches at or somewhat beyond the end of the basal third of the tegmina, has a nearly straight or gently sinuous course toward the apex of the tegmina after passing its basal arcuation, and has four or five, at their origin widely distant but still closely crowded, simple or deeply forked branches, which run in a nearly straight and longitudinal course to the apical fourth of the costal margin. The basal portion of the externomedian vein and its first branch, which is not forked until shortly before the tip, run rather near to the main scapular vein, but after its first forking the externomedian vein has a straight and strongly oblique course to a point on the inner margin at some distance beyond the tip of the mediastinal area, and thereafter has three simple or deeply forked branches having a similar direction to that of the first fork. The internomedian vein is furnished with six or eight rather closely crowded, long, simple, oblique nervules. The anal area is considerably vaulted, the anal furrow deeply impressed, strongly arcuate, and terminates a little beyond the basal third of the tegmina; the anal nervules, six to eight in number, are gently arcuate in the same sense as the anal furrow, subequidistant and simple. The surface is uniformly black, gently vaulted in all the interspaces, excepting those of the internomedian and anal areas, with no banding and but very slight signs of any transverse striation.

Length of tegmina, 18.25 mm.; breadth, 5.9 mm.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, Nos. 2077 *a–b*, *c–d*.

9. Gerablattina uniformis sp. nov.

Pl. X, figs. 8–11.

Known by the tegmina only, which are about two and a half times longer than broad, with very gentle and uniform arcuation to the costal margin and straight inner margin, and probably a broadly rounded tip; the tip in all cases is broken. The mediastinal area is relatively broad and not very long, barely or not extending beyond the middle of the apical half of the tegmina, tapering only in its extreme portion, and filled with strongly oblique, infrequent, simple or forked, more or less arcuate branches. The scapular area must terminate just above the apex of the tegmina; first forking scarcely beyond the middle of the basal half of the same, it has four or five branches, all of which, mostly simple but occasionally deeply forked, have an upward gentle arcuation and on the costal margin are about as equally distant from each other as the mediastinal nervules. The externomedian vein is gently sinuous throughout its course, terminating beyond the middle of the apical third of the tegmina, beginning to fork nearly as soon as the scapular vein, and having in all only three simple or very deeply forked branches, all of which are nearly straight and longitudinal. The internomedian vein is exactly parallel to the externomedian, showing a gentle sinuosity throughout, and is furnished with six or seven simple or deeply forked, strongly oblique, and gently sinuous branches. The anal furrow is rather strongly arcuate, rather deeply impressed, and terminates some distance beyond the end of the basal third of the tegmina; the anal veins are simple and parallel to the anal furrow in its vicinity, where only they are preserved. The surface of the tegmina is uniformly black, approaching piceous, with very faintly perceptible, fine, closely crowded cross lines.

Length of the most perfect specimen (fragment), 13.5 mm.; probable length of tegmina, 17.5 mm.; breadth, 7 mm.

This species is nearly allied to the preceding, *G. concinna*, but is much less slender than it.

It is represented by four specimens from the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, all but one with reverses, which bear the numbers 2082 *a–b*, *c–d*, *e*, *f–g*.

10. GERABLATTINA PERMANENTA sp. nov.

Pl. X, fig. 12.

The tegmina are elongated, regularly and very gently tapering from near the base, and about two and three-quarters times as long as broad. The mediastinal vein extends to beyond the middle of the distal half of the tegmina, the rather narrow area gently narrowing, with half a dozen deeply forked or simple, longitudinally oblique branches, increasingly oblique distally. The scapular vein is at first straight, then bent at its first fork, at about the end of the proximal third of the tegmina, and, thereafter arcuate, crosses to the lower half of the tegmina and terminates a little below the apex; it has but three or four deeply forked, longitudinal, scarcely arcuate branches. The externomedian vein is very unimportant, first branching far beyond the middle of the tegmina and sending only three or four crowded nervules to the margin. The internomedian vein is nearly straight and oblique but apically arcuate, reaching at least as far as the mediastinal vein, with seven or eight equidistant, parallel, straight, simple, oblique branches, the apical ones more longitudinal and sometimes forked. The anal furrow is rather lightly impressed, slightly bent in the middle, and rather broadly arcuate, terminating just before the middle of the tegmina; the six or eight simple, subparallel, subequidistant anal veins are straight and longitudinally oblique, becoming gently arcuate as they approach the anal furrow. The surface of the tegmina is black, in places with distinct, close, incised cross lining.

The single specimen (with its reverse) shows a pair of crossed tegmina, of which only the more perfect, lacking only the extreme tip, is drawn.

Length of better fragment, 14.25 mm.; probable length of tegmina, 15.75 mm.; breadth, 5.7 mm.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, No. 2144 *a–b*.

11. GERABLATTINA PERMACRA sp. nov.

Pl. X, fig. 13.

Tegmina elongate elliptical in form, about three times as long as broad, with very gently and regularly arcuate costal margin and the margin of the anal area a little full. Mediastinal area broadening beyond the base, the vein being broadly sinuate and terminating at about the middle of the distal half of the tegmina; it has eight or nine simple, straight, oblique branches, more frequent in the distal than the proximal half. The scapular vein is very unimportant, although it first forks but little beyond the middle of the proximal half of the tegmina, for it further forks only just before the margin. The externomedian area is extensive; the vein first forks but little beyond the middle of the proximal half of the tegmina, and the two forks are of about equal importance; the upper, which must be regarded as the first branch, having three simple or forked inferior offshoots occupying the apex of the tegmina; the other two superior offshoots, one simple, the other deeply forked. The internomedian vein is very gently arcuate and reaches far beyond the middle of the distal half of the tegmina, and has only three or four longitudinally oblique, simple or forked branches. The anal furrow is very slightly impressed, somewhat strongly arcuate, and terminates scarcely beyond the proximal third of the tegmina; the anal veins are few in numbers, simple, equidistant, and arcuate, parallel to the anal furrow. The surface of the tegmina is blackish brown, and shows in places the feeblest possible signs of fine and close cross lining.

Length of fragment, 15.5 mm.; probable length of tegmina, 17 mm.; breadth, 5.65 mm.

A single specimen and its reverse collected by myself in the Waynesburg coal (Lower Permian) of Cassville, W. Va., shows the whole of one of the tegmina excepting the extreme base and the inner margin. No. 2187 and 2188, United States Geological Survey.

12. GERABLATTINA EVERSA sp. nov.

Pl. X, fig. 14.

The tegmina of this species are broadest at about the middle of the proximal half, and therefore taper apparently very slowly to the apex, and are presumably about two and one-half times longer than broad; but as in the only specimen known most of the margin is lost, much is conjectural in this respect. Assuming, what can not be far wrong, that our restoration of the outline is correct, the mediastinal area, which is of normal width and similar to that of the next preceding species, terminates at about the middle of the distal half of the tegmina and the vein has six or seven straight, longitudinally oblique, simple branches. The scapular vein must terminate about at the apex of the tegmina, being broadly arcuate, with only two or three longitudinal, broadly arcuate branches, the first of which, arising near the middle of the proximal half of the tegmina, is very deeply forked. The externomedian vein is nearly straight and oblique, with two or three broadly arcuate longitudinal branches, simple or forked. The internomedian vein runs in a straight, oblique course, parallel to the last, to about the middle of the distal half of the tegmina, and has only four or five, mostly simple, arcuate, oblique branches, the area rapidly diminishing in diameter as the vein arises high up in the tegmina. The anal furrow is very strongly arcuate, rather sharply but very delicately incised, and terminates but little beyond the middle of the proximal half of the tegmina. The surface is black and shows no sign whatever of any cross lining.

Length of fragment, 11.5 mm.; probable length of tegmina, 15.4 mm.; breadth, 6.2 mm.

The single specimen shows but little more than half of one of the tegmina, with the shoulder, anal area, and a large part of the apex, with more than the distal half of both costal and inner margins, and, the under surface being exposed, is crossed by the veins of the overlying but imperfect hind wing. It comes from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and is from the collection of Mr. R. D. Lacoe, where it bears the number 2145*a*.

13. GERABLATTINA DEDUCTA sp. nov.

Pl. X, fig. 15.

The tegmina, as restored, are long elliptical, of very regular outline, probably tapering as much basally as apically, and about three times as long as broad. The costal margin, beyond the extreme basal narrowing of the tegmina (which is exceptionally great), is very gently and regularly arcuate; the other margins are lost in the only specimen known. The mediastinal vein extends to the end of the fragment and certainly to far beyond the middle of the distal half of the tegmina; it has half a dozen arcuate and rather long, simple or forked branches, and is itself rather far removed from the margin. The scapular vein probably terminates exactly at the apex of the tegmina, first forks at some distance before the middle, with two main stems of about equal value, the branches being nearly longitudinal and on the margin about seven or eight in number. The externomedian vein first branches about opposite the scapular vein, and has only two or three branches, but the first branch is compound, its branchlets divergent, so that it occupies a considerable space and probably sends at least halt a dozen branchlets to the margin. The internomedian vein is regularly arcuate, and terminates before the middle of the distal halt of the tegmina, and has only four or five simple, equidistant, gently arcuate branches. The anal furrow is very gently impressed, roundly bent well beyond the middle, and strikes the margin at the end of the proximal third of the tegmina. The surface is dark brown and everywhere shows delicate cross lines between the veins, very closely crowded and straight.

Length of fragment, 11 mm.; probable length of tegmina, 13.7 mm.; breadth, 4.5 mm.

The single specimen lacks the anal area, the apical sixth of the tegmina and most of the inner margin for a fifth the width of the tegmina. It comes from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and is in the collection of Mr. R. D. Lacoe, with the number 2146*a*.

14. GERABLATTINA SCAPULARIS.

Pl. X, fig. 7.

Gerablattina scapularis Scudd., Bull. U. S. Geol. Surv., No. 101, 19, pl. 2, fig. *l* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

15. GERABLATTINA FRATERNA.

Pl. X, fig. 16.

Gerablattina fraterna Scudd., Bull. U. S. Geol. Surv., No. 101, 19–20, pl. 2, figs. *d*, *e* (1893).

From the Lower (?) Productive Coal-measures of Silver Spring, East Providence, R. I.

16. GERABLATTINA RADIATA sp. nov.

Pl. XI, fig. 1.

A single, nearly perfect fore wing, but with the tip destroyed. It is a little more than twice as long as broad, with widely radiating veins; the costal margin is strongly arcuate, especially on the proximal half, the inner margin nearly straight, and the tip probably roundly pointed. The mediastinal area extends almost to the end of the preserved portion and probably to the apical sixth of the tegmina, and the vein has few, remarkably longitudinal, mostly simple veins, though the middle ones arise from a longitudinal subbasal branch which simulates the main vein. The scapular vein is somewhat as in the genus Archimylacris, for it is strongly arcuate, throughout parallel with the costal margin, and terminates distinctly below the apex of the tegmina, though it apparently does not sweep upward at tip, to judge from the veins next the distal end of the specimen; it first forks at about the end of the proximal third of the tegmina, and has three or four longitudinal branches, simple, deeply forked, or compound. The externomedian vein, very strongly arcuate in the proximal third of the tegmina, is thereafter straight and has but three simple, subequidistant branches parallel to the main scapular vein, the first arising a little before the middle of the tegmina. The internomedian vein is straight beyond the proximal third of the tegmina and terminates only a little before the distal third of the same, with four straight oblique branches, the first very deeply forked, the others simple. The anal furrow is gently arcuate beyond the very strongly arcuate base and ends with the proximal third of the tegmina; the veins are few, simple, and bent arcuate. The veins are discolored with black on a blackish castaneous ground, and there is everywhere a feeble tracery of cross lines.

Length of fragment, 13.5 mm.; probable length of tegmina, 15.5 mm.; breadth, 6.75 mm.

This species is slenderer than those which here follow it, due to the tapering of the tegmina beyond the basal third, and is remarkable for the downward course of the scapular vein, which carries it below the apex of the tegmina.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2147*a*.

17. GERABLATTINA LATA sp. nov.

Pl. XI, fig. 2.

Represented by a single, almost perfect specimen of one of the tegmina; this is only twice as long as broad, of somewhat regular obovate form, the costal margin pretty regularly arcuate, the apex broadly rounded, the inner margin straight. The mediastinal area is tolerably broad and extends to beyond the middle of the apical third of the tegmina, tapering only in its extreme portion, where the mediastinal vein, hitherto parallel to the costal margin, curves rather strongly upward; the area is filled with simple or simply and not deeply forked, strongly oblique nervules, rather few in number but somewhat closely crowded by their obliquity. The scapular vein, first forking but little before the middle of the tegmina, is strongly sinuous, with four, at origin rather distant branches, which are arcuate and upcurved and mostly simple and closely crowded. The externomedian vein is even more strongly sinuous, with but three simple or forked branches, occupying on the apical margin from the extreme apex downward even less space than do the scapular nervules above the apex. The internomedian vein is similarly sinuous and parallel to the externomedian, and has seven generally simple, sometimes simply forked, oblique, nearly straight or gently arcuate branches, the area itself rapidly narrowing beyond the base. The anal area is very gently vaulted with a strongly impressed, arcuate, anal furrow, terminating at about the end of the basal two-fifths of the tegmina; the anal veins are few, distant, strongly arcuate, and subparallel to the anal furrow. The surface of the tegmina is uniformly piceous throughout, and well marked with pronounced but exceedingly delicate and closely crowded tremulous cross lines.

Length, 12.5 mm.; breadth, 6.25 mm.

Represented by one specimen from the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, bearing the number 2148*a*.

18. GERABLATTINA ROTUNDATA sp. nov.

Pl. XI, fig. 3.

This species, represented by a single specimen broken at base, closely resembles *G. lata* in general appearance, having precisely the same form except a straighter costal margin, and being of the same size. It is slightly more than twice as long as broad, with the costal margin straight in the middle half, the apex very broadly rounded, and the anal margin straight before the apical curve. The mediastinal vein is almost perfectly straight, so that the area is triangular and terminates barely before the middle of the distal half of the tegmina; the branches of the vein are rather few, mostly simple, straight and oblique. The scapular vein is gently sinuate and terminates exactly at the apex of the tegmina; it first forks just before the end of the proximal third of the tegmina, and by the middle of the tegmina has sent out three longitudinally oblique, simple, doubly forked, or compound branches, and itself forks once near the tip, so that nearly a dozen branches fall on the upper half of the rounded apical margin of the tegmina. The externomedian vein is similarly sinuate and emits three variably forked branches, farther from the base than the scapular branches, but nearly as numerous on the margin as they. Internomedian vein broadly arcuate but reaching out to the same distance as the mediastinal vein, with four or five simple, nearly straight, oblique branches, traced with exceptional fineness on the stone. Anal furrow not very deeply incised, straight beyond the arcuate basal portion, striking the margin not far before the middle of the tegmina; the anal area is obliterated. With the exception of the internomedian area, the veins are rather deeply incised and black, though not margined, and the whole of the surface of the tegmina is nearly black; there is a feeble sign or two of transverse cross lines in the apical part of the tegmina.

Length of tegmina, 10mm.; breadth, 4.9.

This species is readily distinguished from *G. lata*, its nearest ally, by the straight mediastinal vein and arcuate instead of sinuate internomedian vein.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, No. 2149*a*.

19. GERABLATTINA OVATA sp. nov.

Pl. XI, fig. 4.

The only fragment preserved is broken at the base of the tegmina, but their shape can almost certainly be restored, showing them to have been of a very distinctly ovate form, about twice as long as broad, with the costal margin very regularly and rather strongly convex and the inner margin equally convex in the apical half, producing an ovate tip. The mediastinal vein is sinuous and terminates at about the middle of the apical half of the tegmina, is rather distant from the margin, and has but four or five simple or simply forked and rather long, rather oblique branches. The scapular vein is rather strongly sinuous, terminates barely above the apex of the tegmina, begins to fork at some distance before the middle of the tegmina, and has four simple, in one case deeply forked, nearly straight but slightly sinuous, oblique branches. The externomedian vein, beyond the arcuate base, is nearly straight, begins to fork at about the middle of the tegmina, and has four simple or medially forked, straight, longitudinal branches. The internomedian vein is parallel to the externomedian, and terminates in the middle of the apical two-fifths of the tegmina, with five straight or gently arcuate, oblique, distant branches, of very unequal length, since the area rapidly narrows from base to apex. Only a little of the anal furrow can be seen, but it plainly terminates but a little way before the middle of the inner border. The surface of the tegmina is uniform in coloring and transversely cross lined, as in the preceding species.

Length of fragment, 13.5 mm.; probable length of tegmina, 14.5 mm.; width, 7 mm.

This species is closely allied to *G. lata*, but is of a distinctly different form from the tapering of the apical half of the tegmina, which is scarcely in the least perceptible in the preceding species; the veins again are more longitudinal and less arcuate, and the neuration is also more scant.

The single specimen, represented by obverse and reverse, comes from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and is in the collection of Mr. R. D. Lacoe, bearing the number 2150 *a–b*.

20. GERABLATTINA MINIMA sp. nov.

Pl. XI, fig. 5.

The tegmina would be pretty regularly elliptical in form were it not for the square shoulder formed by the anal area, but, disregarding that, would taper more apically than basally. The costal margin is very regularly and considerably arcuate, but more strongly at base than at apex; the inner margin is nearly straight to the middle of the distal half of the tegmina and then is as arcuate as the costal margin, forming a bluntly subacuminate tip; the tegmina are scarcely more than twice as long as broad and exceptionally small for a Paleozoic cockroach, being indeed the smallest known in this country, except one Permian species. The mediastinal area is of excessive breadth, reaching almost to the middle line of the tegmina, at its widest expansion; the vein is rather strongly sinuate and reaches almost to the middle of the distal fourth of the tegmina; its branches are subparallel, oblique, gently arcuate, generally simple but sometimes deeply forked, and about a dozen in number. The scapular vein is insignificant and closely parallel to the mediastinal vein; it forks only just before the middle of the distal half of the tegmina and has but two simple branches, occupying on the margin only half the narrow space lying between the end of the mediastinal area and the extreme apex of the tegmina. The externomedian vein is also sinuate in the same sense, first forks at about the middle of the tegmina, and has only three simple or forked branches, widely separated at base. The internomedian vein is compound; its principal portion is nearly straight, but at the middle of the tegmina it has a superior apically forked branch which extends its area farther out than the mediastinal area, the main stem having half a dozen rather distant, parallel, transversely oblique, nearly straight, constantly shortening branches. The anal furrow is distinctly impressed, but more by the moderate vaulting of the anal area than by its own incision, is very strongly and regularly arcuate, and strikes the margin at about the distal end of the second fifth of the tegmina; the anal veins are numerous, closely crowded, subsinuate, parallel, longitudinally oblique and mostly simple. The surface of the tegmina is black and in places, particularly in the internomedian area, there are the feeblest possible traces of excessively fine and closely crowded straight cross lines.

Length of tegmina, 9.75 mm.; breadth, 4.7 mm.

This species is most nearly allied to *G. ovata*, but the shape of the tegmina and the relative importance of the mediastinal and internomedian areas are very different.

The single specimen known, with its reverse, is completely preserved, and was obtained by myself in the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Nos. 2183 and 2184, United States Geological Survey.

21. GERABLATTINA FASCIGERA.

Blattina fascigera Scudd., Proc. Bost. Soc. Nat. Hist., XIX, 238–239 (1878).
Gerablattina fascigera Scudd., Mem. Bost. Soc. Nat. Hist., III, 113–115, pl. 6, figs 1 2 (1879); Foss. Ins. N. A., I, 133–135, pl. 6, figs. 1, 2 (1890).

This is the oldest known Paleozoic cockroach.

From the Interconglomerate or Millstone Grit of Campbell's Ledge, near Pittston, Pa.

11. Genus ANTHRACOBLATTINA.

Anthracoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 87–88 (1879); Foss. Ins. N. A., I, 107–108 (1890).

This is rather a characteristic European type of Blattinariæ, for it there holds a second place, while of the fourteen known species only two are American. The geologic range is the same in the two countries, and though in Europe it culminates toward the close of the Carboniferous period, the culmination is in no sense striking, as it is in some genera. In our own country one of the species occurs in the

Lowest Productive Coal-measures of the Western Interior coal-basin in Missouri, the other in the Permian of West Virginia. The genus has not before been recognized in America.

Table of the species of Anthracoblattina.

Large species, the tegmina exceeding 25 mm. in length; scapular vein first forking far earlier than the externomedian.............................. 1. *A. americana.*
Small species, the tegmina less than 12 mm. in length; scapular and externomedian veins first forking at about the same distance from the base.... 2. *A. virginiensis.*

1. ANTHRACOBLATTINA AMERICANA sp. nov.

Pl. XI, fig. 7.

The basal half or thereabouts of a large fore wing represents apparently a species of Anthracoblattina, a genus hitherto unknown in America; the form of the tegmina can, of course, not be told with certainty, but I have attempted to restore the probable outline from the curves of that portion of the costal and inner margins which is preserved and from the course of the principal veins. The tegmina are broad with a broad well-rounded shoulder and a gently arcuate costal and nearly straight inner margin; they are probably a little more than twice as long as broad, and the broadest portion is a little beyond the middle of the anal area. The mediastinal area is remarkably broad, occupying at the base of the wing fully one-half its width, narrowing at first, afterwards remaining nearly equal to a little before the middle of the wing, when it tapers somewhat rapidly, and probably terminates at the end of the middle third of the tegmina, the vein having thus a broadly sinuous course, and throwing off at regular intervals a series (four or five are visible) of long, straight, simple, oblique branches. The scapular vein runs at the extreme base as close as possible beside the externomedian vein, parts from it before the middle of the anal area, and thereafter runs at first parallel to the costal margin; it sends off its first branch before the end of the basal third of the tegmina, its second a little before the middle of the tegmina, the first forking before the origin of the second branch; more than this can not certainly be said from the imperfect nature of the fragment, but it would appear from the course of the veins beside it that it occupies on the costal margin all the portion lying between the mediastinal area and the extreme tip of the tegmina. The externomedian vein is strongly arcuate and first forks opposite the first fork of the first branch of the scapular vein, and from its course and that of the adjoining veins it apparently forks longitudinally in the apical half of the tegmina and occupies on the margin a space considerably less than that of the scapular vein. The internomedian vein runs exactly parallel to the externomedian, and apparently terminates somewhat beyond the middle of the outer half of the tegmina; in the portion which remains it emits two compound, gently arcuate branches, each of them forking doubly before the middle of the tegmina. The anal furrow is deeply and sharply impressed, very strongly arcuate, almost bent at right angles in its proximal half, beyond nearly straight, terminating on the margin just beyond the basal third of the tegmina; the anal area is occupied by but few veins and these at considerable distance from the anal furrow; they are forked or doubly forked, and run in a longitudinally oblique direction, that nearest the anal furrow passing a little above the middle of the area and somewhat arcuate in the same sense as the anal furrow.

Length of fragment, 15.5 mm.; probable length of tegmina, 30 mm.; breadth, 14.5 mm.

The extreme width of the mediastinal area separates this at once from any of the European species of Anthracoblattina.

From a coal bank near Clinton, Mo., belonging to the Lowest Productive Coal-measures. Mr. R. D. Lacoe; one specimen, No. 2137*a*.

2. ANTHRACOBLATTINA VIRGINIENSIS.

Pl. XI, fig. 8.

A nearly perfect fore wing represents a second species, remarkable for the brevity of the internomedian area; the tegmina are smaller and stouter than usual in this genus, being but little more than twice as long as broad, obovate, probably with broadly rounded apex; the costal margin is scarcely arcuate except at the extremities. The mediastinal area is distinctly less than one-third the breadth of the tegmina, at first equal, but gradually approaching the margin in its distal half by the arcuation of the main vein, which reaches the border just before the middle of the distal half of the tegmina; there are about five longitudinally oblique, generally simple, nearly straight branches. The scapular vein is broadly sinuous, being at the base strongly, at the apex feebly, arcuate, terminating at the apex of the tegmina; it first forks well before the middle of the tegmina and has about four mostly deeply forked, feebly arcuate branches, which have much the direction of those of the mediastinal area. The externomedian vein forks fully as soon as the scapular vein and has more branches, the first of which is compound (the others not fully preserved). The internomedian area is exceptionally short for an Anthracoblattina, the main vein being rather strongly arcuate and terminating not far beyond the middle of the tegmina; it has four gently arcuate mostly simple branches. The anal furrow is strongly and very regularly arcuate, not very deeply impressed, and terminates not far from the end of the proximal third of the tegmina; the anal area is not preserved and the other parts of the immediate base are destroyed. The surface of the tegmina is finely, but not very closely, cross-lined, except in the internomedian and the basal portion of the externomedian area, where it is irregularly and not very delicately reticulate.

Length of fragment, 10.5 mm.; probable length of tegmina, 12 mm.; breadth, 5.4 mm.

This species differs from the European species, but perhaps to a less extent from the single other American species, in the brevity of the internomedian area. It is the smallest species of the genus, which contains some of the largest of Paleozoic cockroaches, but it is not much smaller than the European *A. remigii*, from Cusel.

From the Waynesburg coal (Lower Permian), of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2138 *a–b*.

12. Genus HERMATOBLATTINA.

Hermatoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 115 (1879); Foss. Ins. N. A., I, 135 (1890).

This genus was founded upon a couple of species from the Coal-measures of Germany, and one has since been added from the Scottish coal field. It seems to be confined to the uppermost Carboniferous beds and the Permian. No American species have yet been detected.

13. Genus PROGONOBLATTINA.

Progonoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 118–119 (1879); Foss. Ins. N. A., I, 138–139 (1890).

This genus was founded upon a couple of European species, one occurring at the very top of the Carboniferous series in Germany, the other lower down, but in the Productive Coal-measures of Switzerland. None have since been added in Europe, and until now none have been found in America, but we are here able to add a representative from this country. It comes from the Lowest Productive Coal-measures of the Eastern Interior coal field in Illinois. The American species, however, departs less widely than the European from the other Palæoblattariæ in the more normal extent of the internomedian area, which here reaches to the distal end of the middle third of the tegima.

PROGONOBLATTINA COLUMBIANA.

Pl. XI, fig. 9.

The tegmina are of a graceful form, very elongate oval, but with the inner side for the greater part straight, broadest at the end of the proximal third, tapering gradually to a rounded, scarcely pointed apex; both tegmina are perfectly preserved, but the neuration of one is partly lost in unimportant places; the breadth is to the length about as 1: 2.6. The costal margin is very regularly and considerably arcuate, the base ovately rounded and the inner margin straight for two-thirds the length of the tegmina, unaffected by the anal area. The mediastinal area is vittate, the vein extending slightly beyond the middle of the tegmina and the seven or more branches mostly simple, but sometimes deeply forked, increasingly oblique distally. The scapular vein is strongly and pretty uniformly sinuous, terminating just above the apex of the tegmina; on one wing it begins to branch far toward the base of the tegmina as in the other species of the genus, but on the other it does not branch until about the end of the proximal third of the tegmina; yet in the former case, the right side, the vein is much less numerously branched than in the other, although at the same time more strongly sinuous, permitting by its recession from the margin space for a larger number of offshoots; but on this side, as also in the other species of Progonoblattina, the branches are more nearly longitudinal, by which they are reduced in number; on the left fore wing, on the contrary, they are decidedly oblique and excepting the compound basal branch are all simple. The main course of the externomedian vein is, of course, that of the preceding; it first branches not far from the middle of the tegmina, its branches slightly arcuate and nearly longitudinal, the first compound, the others simple. The internomedian vein is regularly and gently arcuate throughout, terminating at about the distal end of the middle third of the tegmina, and has five subequidistant, nearly straight, oblique branches. The anal furrow is strongly and regularly arcuate, deeply impressed, especially toward the base, and strikes the margin a little beyond the end of the proximal third of the tegmina; the half dozen anal veins are simple, arcuate, subequidistant, parallel.

The pronotal shield is also preserved, slightly distorted by pressure. It was apparently subtruncate at base, less than twice as broad as long, strongly convex in front; it appears also to have been considerably vaulted and to have had a large discal, transverse, quadratic impression, nearly twice as broad as long, and there is also trace of a fine margination around all but the base.

The impression of some of the legs, and especially of the hind pair, appears, but only enough to say that they were slender and of a normal length.

Length from front of prothorax to tip of closed tegmina, 26 mm.; of tegmina, 20.75 mm.; breadth of same, 8 mm.; of overlapping tegmina, 14.25 mm.; of prothorax, 9.75 mm.; length of hind femora, 6.5 mm.; breadth of same, 1.75 mm.; length of hind tibia, 4.5 mm.; of tarsi, 6.5 mm.

The single specimen known lies in a natural position, with all the exposed parts preserved, and occurs with its reverse in the center of a nodule from the Lowest Productive Coal-measures of Mazon Creek, Illinois. It was received for study from Mr. William Gurley.

14. Genus ORYCTOBLATTINA.

Oryctoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 121-122 (1879); Foss. Ins. N. A., I, 141-142 (1890).

Five species of this genus are now known—three from Europe and two from North America. The European species are found in later rocks than the American, one occurring in Dyassic, the other two in Upper Carboniferous deposits. One of our two species, indeed, is found in the Barren Coal-measures of the Western Interior coal basin, in Missouri, but the other in the Lowest Productive Coal-measures of the Eastern Interior coal basin in northern Illinois. The type is a very peculiar one, and the resemblance of one of our species (the younger) to the European is very striking, although it is still very clearly distinct; it comes also from a similar horizon.

Table of the species of Oryctoblattina.

Scapular vein with its first branch running close and parallel to the mediastinal throughout.. 1. *O. occidua.*

Scapular vein before branching diverging widely from the mediastinal, only its first branch subparallel to the mediastinal.............................. 2. *O. laqueata.*

1. ORYCTOBLATTINA OCCIDUA.

Oryctoblattina occidua Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 37 (1885); Mem. Bost. Soc. Nat. Hist., IV, 414-415, pl. 32, fig. 3 (1890); Foss. Ins. N. A., I, 390-391, pl. 24, fig. 3 (1890).

Lowest Productive Coal-measures of Mazon Creek, Illinois.

2. ORYCTOBLATTINA LAQUEATA sp. nov.

Pl. XI, fig. 6.

Tegmina only. The tegmina are of an elongate oval form, broadest at the end of the basal third, considerably less than three times as long as broad; the costal margin is strongly arcuate, especially at base, the inner margin gently arcuate, the apex, which is broken, evidently falling about the middle line, perhaps a little below it. The mediastinal vein runs at no great distance from the margin, subparallel to it but gradually approaching it, at last somewhat abruptly, and terminates just beyond the middle of the tegmina; it has many simple, straight, slightly oblique branches, those in the basal half interrupted by a series of connecting cross veins which disturb their regularity. The scapular vein starts in close proximity to the mediastinal in the basal fourth, diverges rapidly from it and thereafter runs at a wide distance from but subparallel to it, terminating a little less than midway between the tip of the mediastinal vein and the apex of the tegmina, and in this last portion of its course, from just before the tip of the mediastinal vein, sends to the border numerous very crowded, straight, oblique, simple veins; just beyond its change of course the scapular vein throws off a principal branch, which emits several inferior nervules at rather wide distances apart toward the apex of the tegmina; most of these branches are simple for the greater portion of their course, or they may be deeply forked, so that eight or nine nervules strike the margin; besides this, in the interspace between the main vein and its principal branch, there is thrown off from the upper side of the principal branch a short, widely diverging vein. The externomedian vein runs in a nearly straight, gently sinuate course at no great distance from the scapular vein and its lowest branch to the inner margin, at no great distance before the tip; it has but a single branch, originating opposite the first furcation of the principal mediastinal branch, but at its origin obscured by the reticulation of the tegmina and distinct only beyond the middle of the wing, at which it divides into two distally branching veins. The internomedian vein forks close to the base, its lower branch simple, straight, and running in close proximity to the anal furrow, its upper branch forking widely opposite the tip of the former; the space upon the margin between its forks as well as between these and the lower branch is filled with numerous oblique, straight, closely crowded branches similar to the upper branches of the main scapular stem. The anal furrow is sharply but not deeply impressed, gently arcuate at the base, beyond nearly straight; of the anal veins only a pair can be seen, parallel to the anal furrow and not closely crowded. The whole surface is covered with a minute but sharp reticulation of cross veins forming cells which are generally polygonal, but, by reason of the direct or nearly direct transversality of the cross veins, mostly quadrilateral in the scapular and anal areas and between the scapular and mediastinal veins, except in the interspaces between the straight, closely crowded, marginal branches of both the costal and inner borders, which are free.

This species is remarkably similar to and yet very distinct from *O. reticulata* of the German coal, and is another remarkable instance of the similarity of many forms in the European and American Coal-measures. The general resemblance is most striking, due to the sharp and minute reticulation of the tegmina, the multiplicity of the short branches which crowd the margin in certain spots, and the general form and relative importance of the scapular vein, with its branches almost wholly dependent on not the main vein but its principal branch. It differs in the very different form of the tegmina, the lack of an independent curve to the anal area, and in the wide basal branching of the internomedian vein. As will be seen, *O. laqueata* bears a much stronger resemblance to the European species than to *O. occidua*, the only American species hitherto known.

Length of fragment, extreme tip and base being lost, 17.5 mm.; probable length of wing, 21 mm.; breadth, 7.5 mm.

The single specimen, from the Coal-measures of Kansas City, Mo., was collected by Mr. Sidney J. Hare about 170 feet above the base of the Upper Barren Coal-measures, and is in the collection of Mr. R. D. Lacoe, under the number 2136*a*.

15. Genus POROBLATTINA.

Poroblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 38–39 (1885).

First described from the Triassic rocks of Colorado, where three species occur; it has now been found, not only in the Permian of West Virginia, where three more species are found, but even in the Barren Coal-measures of eastern Ohio, in which two other species are recognized, or eight species in all. It thus ranges from the Barren Coal-measures to the Trias, and, as far as yet appears, is an exclusively American type.

Table of the species of Poroblattina.

- a^1. Mediastinal area extending well beyond the middle of the tegmina; externomedian vein first forked beyond the extremity of the anal furrow.
  - b^1. Externomedian vein simple, or, if forked, divided only at extreme tip. 1. *P. longinqua.*
  - b^2. Externomedian vein more or less and deeply forked.
    - c^1. Scapular vein terminating at or above the tip of the tegmina; internomedian vein and branches oblique and nearly straight.
      - d^1. Mediastinal area narrowing only near extremity, which reaches far beyond the middle of the distal half of the tegmina; scapular vein sinuous, its branches almost longitudinal .... 2. *P. gratiosa.*
      - d^2. Mediastinal area narrowing throughout distal half and reaching only to middle of distal half of tegmina; scapular area arcuate, its branches distinctly oblique .... 3. *P. fossa.*
    - c^2. Scapular vein terminating below the tip of the tegmina; internomedian vein and branches strongly arcuate .... 4. *P. meieri.*
- a^2. Mediastinal area terminating distinctly short of the middle of the tegmina; externomedian vein first forked opposite the extremity of the anal furrow.
  - b^1. Scapular vein strongly sinuous, the proximal series of branches simple. 5. *P. arcuata.*
  - b^2. Scapular vein gently sinuous, the proximal series of branches deeply forked.
    - c^1. Externomedian vein with few, distant, and simple branches.
      - d^1. Internomedian vein long, with numerous but distant branches. 6. *P. lakesii.*
      - d^2. Internomedian vein short, with very few branches .... 7. *P. ohioensis.*
    - c^2. Externomedian vein with numerous, crowded, and often forked branches. 8. *P. complexinervis.*

1. POROBLATTINA LONGINQUA.

Pl. XI, fig. 12.

Although the single specimen at hand is very fragmentary and scarcely shows a natural border at any point, the portion preserved shows the larger part of the neuration and its most essential features, which are somewhat strikingly different from those of any other species. Apparently the tegmina were of a slender ovate form, about two and a half times longer than broad, though this is conjectural. The mediastinal area is vittate and rather narrow, the vein with rather distant gently arcuate simple branches, and evidently ends well beyond the middle of the tegmina. The scapular vein is gently and very broadly sinuous, and retreats so from the costal margin as probably to terminate at some considerable distance below the apex of the tegmina, which is one of its striking peculiarities; it first forks a little before a point opposite the extremity of the anal furrow, and in the fragment has but two branches, both of which are or must be forked if not compound, and probably a third branch arises at a long distance from the second; all these branches are very longitudinally oblique. The externomedian vein is simple as far as it can be traced, which is through at least three-fourths of its course; it runs in a sinuous course, midway between and distant from the adjacent veins. The internomedian vein is similarly sinuous, and in the preserved portion has three (probably there are in all four or five) nearly straight and oblique distant branches. The anal furrow is feebly incised, arcuate, and scarcely bent in the middle, and terminates probably well beyond the middle third of the tegmina; anal veins not preserved. The internomedian veins are very delicate, the others rather coarse, and all are broadly bordered on each side with carbonaceous black, which in the internomedian area shows traces of delicate cross lines.

Length of fragment, 15 mm.; probable length of tegmina, 22 mm.; breadth, 8.5 mm.

In the simple or only apically forked externomedian vein and the downward embrasive sweep of the scapular vein, including the whole apex of the tegmina, this species differs strikingly from all its allies.

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, No. 111.

2. POROBLATTINA GRATIOSA.

Pl. XI, fig. 13.

The tegmina, in the single instance known nearly complete, hardly taper apically, but are slender, being fully two and one-half times longer than broad, the costal margin rather gently arcuate, the inner margin straight, the apex probably well rounded. The mediastinal area is vittate and tolerably broad, extending to not very far short of the apex of the tegmina; the vein has seven or eight similar, simple, strongly oblique, nearly straight branches. The scapular vein is somewhat sinuate and terminates at the very apex of the tegmina; it branches early, well before the tip of the anal furrow and within the proximal fourth of the tegmina; in all there are about five feebly arcuate, longitudinal, mostly simple branches, arising at somewhat unequal distances apart. The externomedian vein is very feebly sinuous, longitudinally oblique, with three straight, simple or forked, very longitudinally oblique branches arising at very unequal distances apart, the earliest a little beyond the tip of the anal furrow. The internomedian vein is very broadly arcuate (too straight in the figure) and ends before the middle of the distal half of the tegmina, and has but three nearly straight, oblique, simple or simply forked branches. The anal furrow is lightly impressed, rather regularly and rather strongly arcuate, ending on the margin not a great way beyond the proximal fourth of the tegmina; anal area lost. The entire surface is uniformly carbonaceous black and marked with exceedingly delicate, closely crowded cross lines.

Length of fragment, 11 mm.; probable length of tegmina, 13.5 mm.; breadth, 5 mm.

The great length of the mediastinal area and the infrequent branching of the scapular and externomedian veins distinguish this species from *P. fossa*, its nearest ally. Its most striking peculiarity is the behavior of the externomedian vein.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2134 *a–b*.

3. POROBLATTINA FOSSA.

Pl. XI, fig. 15.

Tegmina oblong ovate in form, much more than two and one-half times longer than broad, with regularly and considerably arcuate costal margin and nearly straight inner margin. The mediastinal vein is nearly straight, with a very gentle arcuation beyond the base, and reaches nearly to the distal end of the middle third of the tegmina; its branches are straight, simple, and very longitudinally oblique. Beyond the base the scapular vein is gently and broadly arcuate, striking the apex of the tegmina; it first branches within the proximal third of the tegmina, the branch doubly forked, and thereafter, about the middle of the tegmina, has three more simple or forked branches, all parallel to those of the mediastinal area. Beyond the base the externomedian vein is straight and oblique, with three or four forked or doubly forked longitudinal branches, the first thrown off at some distance beyond the origin of the first scapular branch. The internomedian vein, beyond its gently arcuate base, is straight, parallel to the internomedian vein, and strikes the margin at the distal end of the middle fifth of the tegmina; it has four or five straight, oblique, simple branches, the first sometimes forked. The anal furrow is regularly and considerably arcuate, but little impressed, and strikes the margin at about the end of the proximal third of the tegmina; anal area not preserved. The internomedian veins are lightly impressed and delicate, the others rather deeply and coarsely; the surface is uniformly blackish, and there is no trace of marking or other sculpture.

Length of better fragment, 14 mm.; probable length of tegmina, 16.5 mm.; breadth, 6 mm.

This species is most nearly allied to the preceding, from which it differs in the form and length of the mediastinal area, the more oblique and numerous scapular veins, the more strongly convex costal margin, and probably in the form of the apex of the tegmina.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2083 *a–b*, *c*.

4. POROBLATTINA MEIERI.

Petrablattina meieri Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 38 (1885); Mem. Bost. Soc. Nat. Hist., IV, 465, pl. 42, fig. 17[1] (1890); Foss. Ins. N. A., I, 441, pl. 34, fig. 17[1] (1890).

This species was wrongly referred by me to Petrablattina.

Triassic of Fair Play, Colo.

5. POROBLATTINA ARCUATA.

Poroblattina arcuata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 39 (1885); Mem. Bost. Soc. Nat. Hist., IV, 466, pl. 41, fig. 5 (1890); Foss. Ins. N. A., I, 442, pl. 33, fig. 5 (1890).

Triassic of Fair Play, Colo.

6. POROBLATTINA LAKESII.

Poroblattina lakesii Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 39 (1885); Mem. Bost. Soc. Nat. Hist., IV, 466, pl. 41, fig. 11 (1890); Foss. Ins. N. A., I, 442, pl. 33, fig. 11 (1890).

Triassic of Fair Play, Colo.

7. POROBLATTINA OHIOENSIS.

Pl. XI, fig. 11.

The apical third or more of the only specimen known is unfortunately lost, but the tegmina are very slender and must have been more than three times as long as broad; the costal margin is very slightly arcuate beyond the base and the inner margin straight, so that the tegmina taper very slightly and probably had a well-rounded apex. The mediastinal area is very brief and narrow and the main vein very slightly arcuate, ending but a little beyond the proximal third of the tegmina, with three or four longitudinally oblique, simple, and straight branches. The scapular is far the most important of the veins, with a sinuous course through the middle of the tegmina, terminating at the apex; it sends out a large number of branches, not very crowded, either simple or deeply forked, occasionally doubly forked, the first of which is emitted far toward the base of the tegmina or about opposite the middle of the anal area; the branches are more or less arcuate and oblique. The externomedian vein is broadly sinuous and oblique, and in the part preserved shows but two branches, which are simple, but in all probability they fork in the apical portion, as there is abundant room for it. The internomedian vein runs parallel to the externomedian and strikes the inner margin not far from the middle of the tegmina; it is badly preserved and remarkably insignificant, but probably has one or two short oblique branches. The anal furrow is deeply impressed at base, but beyond only delicately incised, pretty regularly and not very strongly arcuate, and strikes the inner margin beyond the proximal third of the tegmina; the anal veins that can be seen in the portion most removed from the furrow are arcuate in a sense the reverse of that of the furrow, closely crowded, and most of them deeply forked. The scapular veins are as deeply incised as the anal furrow; the others are more delicate; the whole surface is black, and there is no sign of cross lining.

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[1] Erroneously marked 13 on plate. See note on p. 87.

Length of fragment, 7.5.mm.; probable length of tegmina, 11 mm.; breadth at tip of anal furrow, 3.5 mm.

The tegmina are peculiar for the insignificance of the internomedian area and the contrast between the two lateral halves, as to the number and prominence of the nervules. It bears no special resemblance to any of the others.

From the Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, No. 162.

8. POROBLATTINA COMPLEXINERVIS.

Pl. XI, fig. 14.

The last species of Poroblattina is represented by a single specimen of one of the tegmina, perfect in every part excepting insignificant fractures from the base and tip. The tegmina are of a very graceful subovate form, with well rounded outlines, nearly two and three-quarters times as long as broad; the costal margin is considerably and very regularly convex, the inner margin straight except at base and tip, the apex well rounded and subacuminate; the tegmina are crowded with nervures. The mediastinal area is short and narrow, terminating at the distal end of the second fifth of the tegmina, the vein with four or five oblique simple branches. The scapular vein is broadly and gently sinuous, terminating a little above the apex, with six or seven tolerably straight, oblique, generally forked branches, arising subequidistantly, the earliest about opposite the middle of the anal area. The externomedian vein is very peculiar; simple and arcuate until beyond the tip of the anal area, it appears here to throw off numerous branches on each side as it runs toward a point as far below the apex as the tip of the scapular vein is above it; but in reality it runs parallel to the internomedian vein (as in the other species of the genus), while one of its middle branches is complexly compound, spreading fan-shaped with numerous offshoots filling the lower apical portion of the tegmina, the other branches before and after it being usually simply forked. The internomedian vein is broadly arcuate, though nearly straight in its middle half, and terminates somewhat beyond the middle of the tegmina; it has a number of feebly sinuous, straight and oblique, crowded branches. The anal furrow is deeply impressed, at least at base, and strongly arcuate, terminating on the inner margin scarcely beyond the proximal third of the tegmina; the anal veins are very numerous, mostly simple and arcuate, less so and more crowded away from the anal furrow. The anal and internomedian veins are delicately traced, the others more pronounced; the whole surface is carbonaceous black, and shows nowhere any sign of cross lines.

Length of tegmina, 16.75 mm.; breadth, 6.25 mm.

This species resembles the Triassic species more than do any of the other Paleozoic forms, but it differs widely from them and indeed from all the others in the crowded venation, and in the complicated distribution of the externomedian branches.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2135 *a–b*.

16. Genus PETRABLATTINA.

Petrablattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 123–124 (1879); Foss. Ins. N. A., I, 143–144 (1890).

This is a second genus found both in Paleozoic and Mesozoic rocks. One Triassic species formerly referred here really belongs in Poroblattina (*P. meieri*), but *Petrabl. æqua* from the same rocks undoubtedly belongs here. One of the other two American species, like the single European species, occurs in the Permian (of West Virginia); the other, on the contrary, is a far older form, coming from probably the Lowest Productive Coal-measures in the Acadian coal basin, near the upper limit of the Millstone Grit.

Table of the species of Petrablattina.

a^1. Mediastinal area reaching much beyond the middle of the tegmina; internomedian area wholly within the basal half of the tegmina........ 1. *P. sepulta.*

a^2. Mediastinal area reaching scarcely or not beyond the middle of the tegmina; internomedian area extending more or less into the distal half of the tegmina.

  b^1. Scapular vein terminating at the tip of the tegmina; internomedian area reaching but little beyond the middle of the tegmina .... 2. *P. hastata.*

  b^2. Scapular vein terminating far before the tip of the tegmina; internomedian area reaching well beyond the middle of the tegmina.......... 3. *P. æqua.*

1. PETRABLATTINA SEPULTA.

Blattina sepulta Scudd., Proc. Amer. Assoc. Adv. Sc., XXIV, B, 111, fig. 2 (1876); Can. Nat., n. s., VIII, 89–90, fig. 2 [1] (1876).

Petrablattina sepulta Scudd., Mem. Bost. Soc. Nat. Hist., III, 125–126, pl. 6, fig. 7 (1879); Foss. Ins. N. A., I, 145–146, pl. 6, fig. 7 (1890).

From the very Lowest Productive Coal-measures of Sydney, Cape Breton Island.

2. PETRABLATTINA HASTATA.

Pl. XI, fig. 10.

The tegmina are of a subtriangular shape, about two and one-half times longer than broad, tapering rather rapidly almost from the base, the costal margin gently convex, the inner margin nearly straight. The apex is broken in the only specimen seen, but must have been more or less pointed, and probably rounded as represented in the figure. The mediastinal area is moderately broad and short, not extending to the middle of the tegmina, with five or six mostly simple, nearly straight, oblique branches. The scapular vein is broadly sinuous, running beyond the proximal third of the tegmina, through the middle of the same, and terminating at or scarcely above the apex; it branches early, before the end of the proximal third of the tegmina, the first branch simple, the others compound or forked, so that probably ten or twelve nervules strike the margin, and all are nearly longitudinal. The externomedian vein is strongly and pretty regularly arcuate, striking the inner margin scarcely beyond a point opposite the tip of the mediastinal vein, and having three simple or apically forked branches which are nearly longitudinal, but descend slightly toward the inner margin, the proximal branch arising well beyond the middle of the vein. The internomedian vein is parallel to the externomedian and has but two forked and arcuate branches. The anal furrow is similarly arcuate, rather deeply impressed, and strikes the margin a little beyond a point opposite the first branching of the scapular vein; the anal veins are numerous and rather deeply forked, more closely crowded proximally than distally, and, from forking, more crowded next the margin than away from it. The internomedian and anal veins, and especially the former, are very delicately traced, while the others are rather heavily impressed; the whole surface is uniformly coal black, and there is no trace of other sculpture than the venation.

Length of fragment, 6.5 mm.; probable length of tegmina, 8.25 mm.; breadth at end of anal furrow, 3.5 mm.

In the form of the tegmina *P. hastata* differs decidedly from either of the other species of the genus, but in its neuration it agrees better with the Carboniferous than with the Triassic species; all three species are widely different. It is the smallest Paleozoic cockroach known from this country.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2133 *a–b*.

3. PETRABLATTINA ÆQUA.

Petrablattina æqua Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 38 (1885); Mem. Bost.[1] Soc. Nat. Hist., IV, 465, pl. 42, fig. 13[1] (1890); Foss. Ins. N. A., I, 441, pl. 34, fig. 13. (1890).

Trias of Fair Play, Colo.

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[1] Erroneously marked 9 on the plate. See note to p. 87.

Genus LEPTOBLATTINA.

Leptoblattina Woodw., Geol. Mag., Dec. iii, Vol. IV, 58 (1887).

This is an exclusively European type of cockroach. Two species are known, one from the very oldest true Coal-measures, the other possibly from the same or slightly younger rocks.

DESCRIPTION OF THE HIND WING OF A GIGANTIC SPECIES.

BLATTINA sp.

Pl. X, fig. 16.

A single specimen of a hind wing of enormous size differs so much from any other known that I use for it, as a convenience merely, the old generic term Blattina, as applied to fossil cockroaches in general. It is nearly complete, and shows that the costal margin was gently and nearly uniformly arcuate, the inner margin very strongly and probably uniformly arcuate, the apex falling scarcely below the middle of the upper half of the wing and subacuminate but well rounded. The mediastinal vein is straight, runs very near to and parallel with the margin, and terminates almost at the distal end of the middle third of the wing; the area is broken so that only a couple of apical branches can be seen. The scapular vein is almost rigidly straight and terminates at some distance below the extreme apex of the wing, divides at the very root into two main branches which again fork in the basal fourth of the wing; the branchlets of both are superior, those of the upper stem much the more numerous and often compound, those of the lower feeding that part of of the margin lying below the apex and all longitudinal, those of the upper stem apically arcuate, especially in their terminal members. The externomedian vein is straight and runs through nearly the middle line of the wing, gradually passing into the lower half by its divergence from the scapular, first forks at about the end of the proximal third of the wing, and thereafter sends out arcuate sublongitudinal offshoots on either side indiscriminately, which do not fork before their middle. The internomedian vein is bent-arcuate, subparallel to the externomedian before that forks, is then bent, and ends a very little farther out than the mediastinal vein; it has only a couple of very oblique branches, the the distal one twice deeply forked. No anal veins can be traced. The interspaces near the apex show a somewhat irregular tremulous cross lining, not very crowded.

Length of fragment, 47 mm.; probable length of entire wing, 51 mm.; breadth of fragment, 24.5 mm.; probable complete breadth, 25.25 mm.

The complete correspondence of the long mediastinal area in this wing to that of Etoblattina in the few examples known, and the strong probability that the area in question will be found to be very short and perhaps triangular in the Mylacridæ, lead me to believe that this wing should be referred to the Blattinariæ and not to the Mylacridæ. Its excessive size, which shows it to belong to one of the largest fossil cockroaches yet discovered, would at first seem to recall the Mylacridæ, but it should not be forgotten that some species of Etoblattina, such as *E. didyma* and notably *E. illustris*, rival the largest Mylacridæ known. The only two species of Etoblattina known from the same fauna as this wing are of only about one-half its size. It plainly, therefore, belongs to a species, the tegmina of which are yet undescribed. Its variance from what we know of the hind wings of Etoblattina, however, prevent our placing it, at least for the present, in that genus, and it seems best to refer it simply to "Blattina," as a "magazine" genus.

From the Lowest Productive Coal-measures of Mazon Creek, Illinois. Mr. R. D. Lacoe, No. 2038*a*.

NEOBLATTARIÆ

With a few Triassic exceptions, this division embraces all the cockroaches which are known from later than Paleozoic times.

17. Genus NEORTHROBLATTINA.

Neorthroblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 108–109 (1885).

A genus confined, as far as known, to the Triassic rocks. Four species have been found in central Colorado.

Table of the species of Neorthroblattina.

- *a*¹. Fore wings not more than two and one-half times as long as broad: mediastino-scapular vein terminating only a little before the tip of the tegmina.
  - *b*¹. Internomedian vein beginning to fork long before the externomedian and of equal importance with it .... 1. *N. albolineata.*
  - *b*². Internomedian vein beginning to fork scarcely or not before the externomedian and of less importance than it.
    - *c*¹. Internomedian area terminating much farther from the apex of the tegmina than the mediastino-scapular .... 2. *N. lakesii.*
    - *c*². Internomedian area reaching out toward the apex of the tegmina nearly as far as the mediastino-scapular .... 3. *N. rotundata.*
- *a*². Fore wings about three times as long as broad; mediastino-scapular area terminating long before the tip of the tegmina .... 4. *N. attenuata.*

1. NEORTHROBLATTINA ALBOLINEATA.

Neorthroblattina albolineata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 109 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, pl. 42, figs. 2, 18 (1890); Foss. Ins. N. A., I, 336, 443, pl. 34, figs. 2, 18 (1890).

Triassic of Fair Play, Colo.

2. NEORTHROBLATTINA LAKESII.

Neorthroblattina lakesii Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 109 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, 468, pl. 42, figs. 9, 15[1] (1890); Foss. Ins. N. A., I, 336, 443, 444, pl. 34, figs. 9, 15[1] (1890).

Triassic of Fair Play, Colo.

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[1] Erroneously marked 10 and 16 on plate. See note on p. 87.

3. NEORTHROBLATTINA ROTUNDATA.

Neorthroblattina rotundata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 109–110 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, 468, pl. 42, figs. 7, 8 (1890); Foss. Ins. N. A., I, 336, 443, 444, pl. 34, figs. 7, 8 (1890).

Triassic of Fair Play, Colo.

4. NEORTHROBLATTINA ATTENUATA.

Neorthroblattina attenuata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 110 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, 468–469, pl. 42, fig. 1 (1890); Foss. Ins. N. A., I, 336, 443, 444–445, pl. 34, fig. 1 (1890).

Triassic of Fair Play, Colo.

18. Genus SCUTINOBLATTINA.

Scutinoblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 110 (1885).

A second genus confined, as yet known, to the Trias and to central Colorado, where three species occur.

Table of the species of Scutinoblattina.

a^1. Mediastino-scapular and externomedian veins having a distinctly sinuous course through the middle of the tegmina, both terminating below the apex.
  b^1. Anal branches falling on the hind margin .... 1. *S. brongniarti.*
  b^2. Anal branches falling on the anal furrow .... 2. *S. intermedia.*
a^2. Mediastino-scapular and externomedian veins taking a straight course through the middle of the tegmina, both terminating at the tip .... 3. *S. recta.*

1. SCUTINOBLATTINA BRONGNIARTI.

Scutinoblattina brongniarti Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 110–111 (1885) Mem. Bost. Soc. Nat. Hist., IV, 469, pl. 42, fig. 5 (1890); Foss. Ins. N. A., I 370, 445, pl. 34, fig. 5 (1890).

Triassic of Fair Play, Colo.

2. SCUTINOBLATTINA INTERMEDIA.

Scutinoblattina intermedia Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 111 (1885); Mem. Bost. Soc. Nat. Hist., IV., 469, 470, pl. 42, fig. 4 (1890); Foss. Ins. N. A., I, 370, 445, 446, pl. 34, fig. 4 (1890).

Triassic of Fair Play, Colo.

3. SCUTINOBLATTINA RECTA.

Scutinoblattina recta Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 111, (1885); Mem. Bost. Soc. Nat. Hist., IV, 469, 470, pl. 42, fig. 3, 16[1] (1890); Foss. Ins. N. A., I, 370, 445, 446, pl. 34, figs. 3, 16[1] (1890).

Triassic of Fair Play, Colo.

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[1] Erroneously marked 17 on plate. See note on p. 87.

20. Genus ZETOBORA.

a Burm., Handb. Entom, II, 509–510 (1838).

extant genus, recognized in the Tertiary rocks of Colorado.

ZETOBORA BRUNNERI.

ı brunneri Scudd., Tert. Ins. N. A., 217, pl. 17, fig. 12 (1890).

iary of Florissant, Colo.

19. Genus HOMŒOGAMIA.

ramia Burm., Handb. Entom., II, 490 (1838).

opical American living type of cockroaches; also recognized in rtiary of Colorado by a single species.

HOMŒOGAMIA VENTRIOSUS.

amia ventriosus Scudd., Bull. U. S. Geol. Surv. Terr., I, 447 (1876); Tert. Ins. ւ., 218, pl. 17, fig. 8 (1890).

iary of Florissant, Colo.

21. Genus PARALATINDIA.

ːdia Sauss., Rev. Mag. Zool., XXXI, 100–101 (1868).

stinctively American type of living cockroaches, of which one pecies occurs in the Tertiaries of Wyoming.

PARALATINDIA SAUSSUREI.

ndia saussurei Scudd., Tert. Ins. N. A., 216, pl. 6. fig. 25 (1890).

ary of Green River, Wyoming.

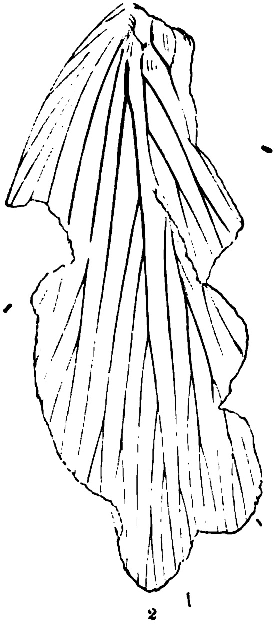
PLATES

PLATE I.

EXPLANATION OF PLATE I.

Figs. 1 and 4 are from the originals of the Illinois geological survey. Figs. 2, 3, and 5 were drawn by J. Henry Blake; fig. 6 by J. H. Emerton. All the figures are magnified two diameters, excepting figs. 1 and 4, which are of natural size.

Fig. 1. Mylacris anthracophila; pronotum. Colchester, Ill.
2. Mylacris packardii. Bristol, R. I.
3. Mylacris packardii. Bristol, R. I.
4. Mylacris anthracophila; one of the tegmina. Colchester, Ill.
5. Mylacris gurleyi. Mazon Creek, Illinois.
6. Mylacris elongata (2014). Mazon Creek, Illinois.



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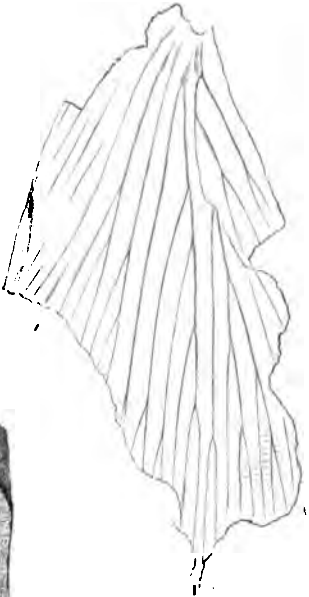

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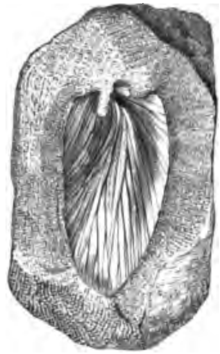

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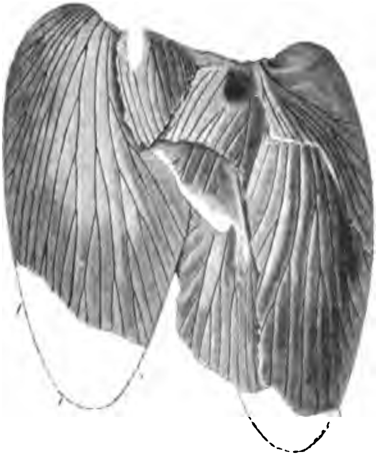

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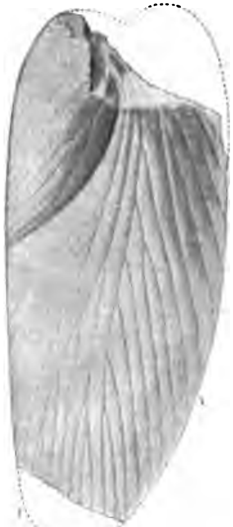

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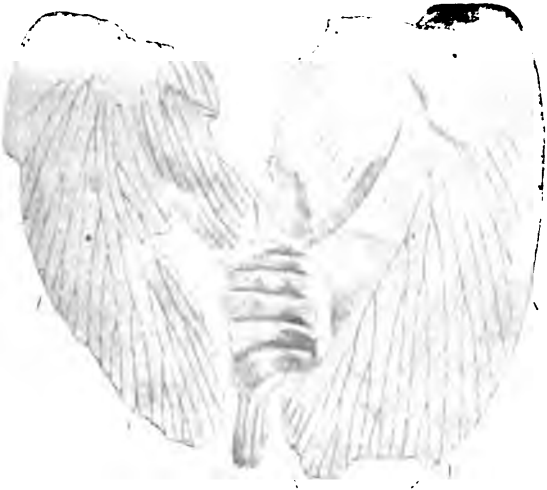
MYLACRIDÆ: SPECIES OF MYLACRIS.

PLATE II.

EXPLANATION OF PLATE II.

Figs. 2 to 4 were drawn by J. Henry Blake; the others by Katherine Peirson Ramsay. All are magnified two diameters.

Fig. 1. Mylacris ampla (2021). Mazon Creek, Illinois.
2. Promylacris testudo (2089). Mazon Creek, Illinois.
3. Promylacris harei (2087). Kansas City, Mo.
4. Mylacridæ sp. Mazon Creek, Illinois.
5. Mylacris antiqua (2036*a*). Mazon Creek, Illinois.
6. Mylacris antiqua (2036*b*). Mazon Creek, Illinois.



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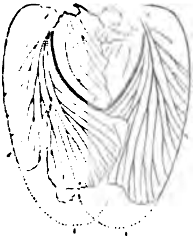

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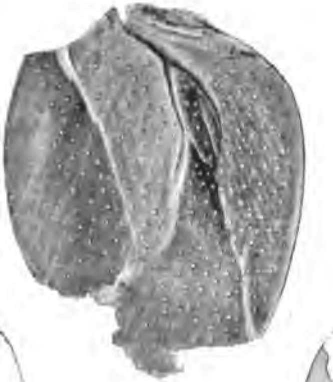

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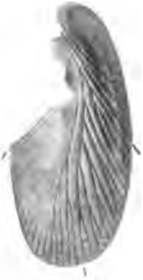

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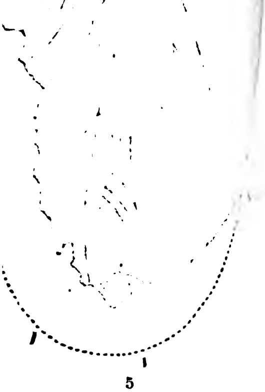

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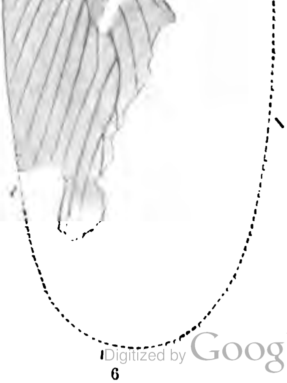


6

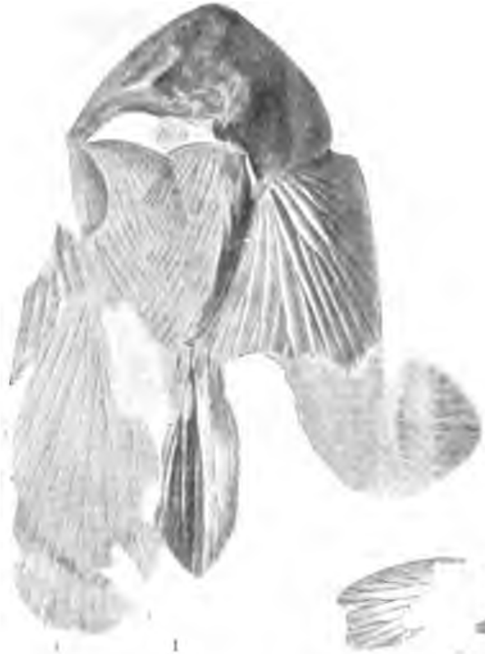
MYLACRIDÆ: SPECIES OF MYLACRIS AND PROMYLACRIS.

PLATE III.

EXPLANATION OF PLATE III.

All the drawings are by J. Henry Blake, and magnified two diameters.

Fig. 1. Promylacris rigida (2086). Mazon Creek, Illinois.
2. Paromylacris ? pluteus (2040). Pittston, Pa.
3. Paromylacris triangularis (2110). Mazon Creek, Illinois.
4. Paromylacris ampla (2088). Mazon Creek, Illinois.
5. Microblattina perdita (2092). East Providence, R. I.
6. Paromylacris clintoniana (2151). Clinton, Mo.



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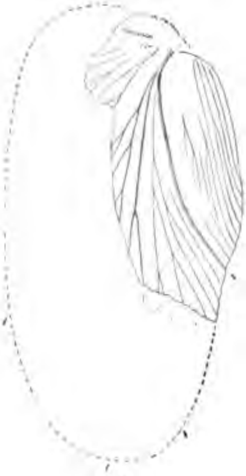

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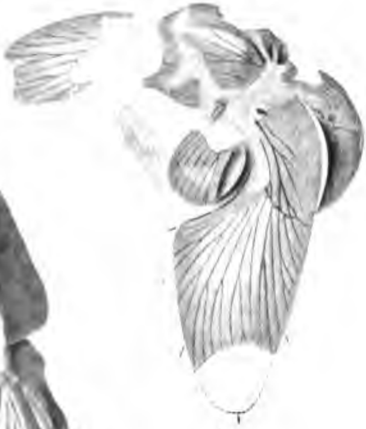

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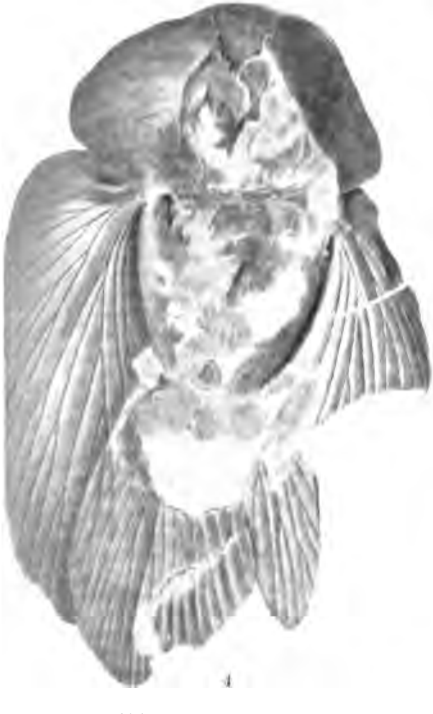

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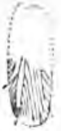

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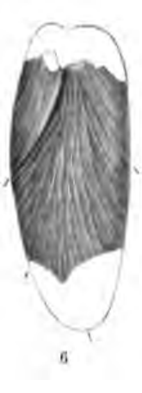


6

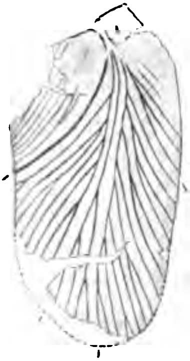
MYLACRIDÆ: SPECIES OF PROMYLACRIS AND PAROMYLACRIS.
BLATTINARIÆ: SPECIES OF MICROBLATTINA.

PLATE IV.

EXPLANATION OF PLATE IV.

All the drawings are by J. Henry Blake, excepting figs. 2 to 4 by S. H. Scudder, and fig. 10 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Etoblattina clintoniana (2182). Clinton, Mo.
2. Etoblattina lata (2099). Cassville, W. Va.
3. Etoblattina sagittaria (2100). Cassville, W. Va.
4. Etoblattina mediana (2101). Cassville, W. Va.
5. Etoblattina fossa (182). Richmond, Ohio.
6. Etoblattina ovata (2102). Cassville, W. Va.
7. Etoblattina scholfieldi. East Providence, R. I.
8. Etoblattina debilis (2103). Cassville, W. Va.
9. Etoblattina patiens (2104). Cassville, W. Va.
10. Etoblattina strigosa. Richmond, Ohio.
11. Etoblattina illustris. Pawtucket (?), R. I.
12. Etoblattina detecta (2106*a*). Cassville, W. Va.
13. Etoblattina detecta (2106*c*). Cassville, W. Va.



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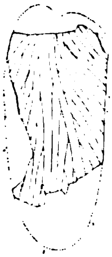

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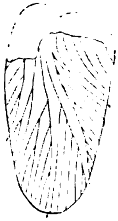

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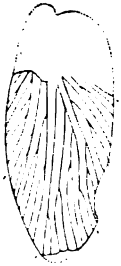

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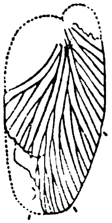

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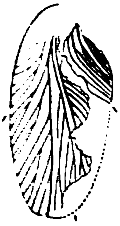

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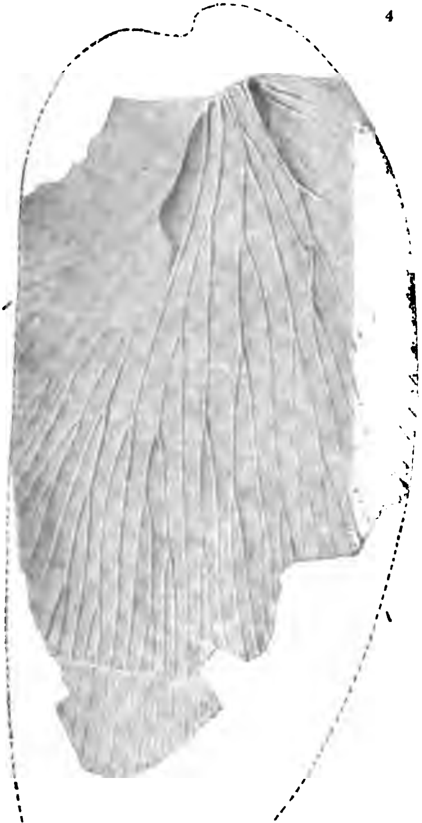

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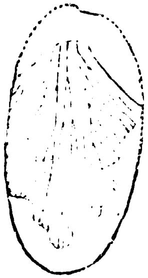

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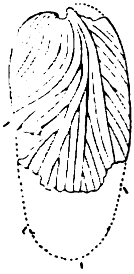

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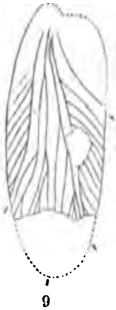

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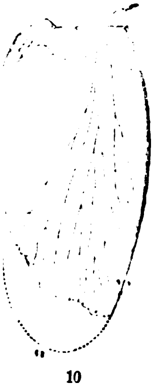

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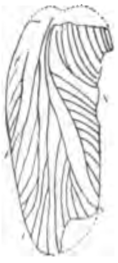

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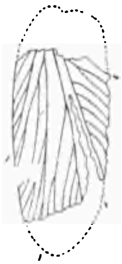


13

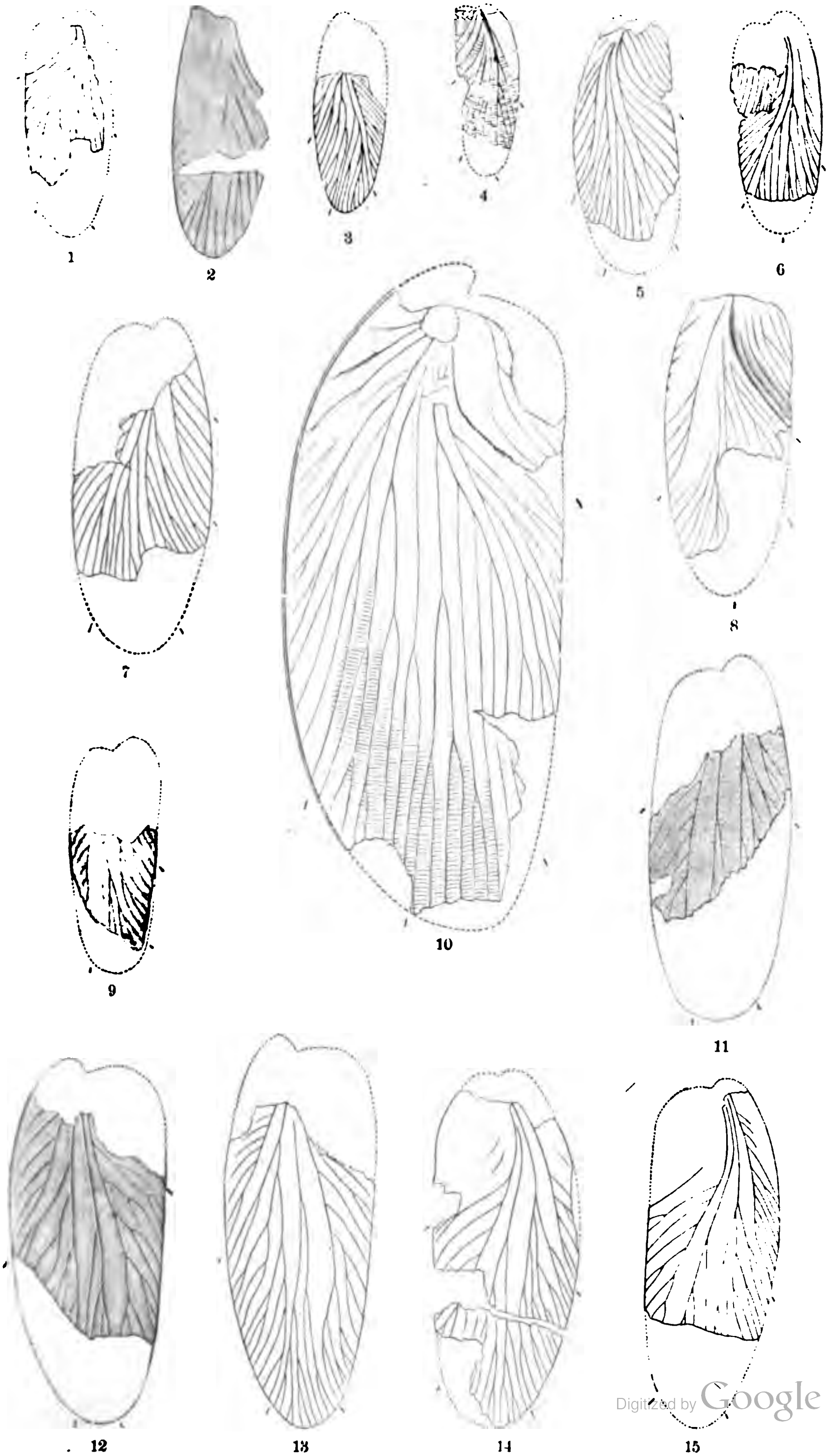
BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE V.

EXPLANATION OF PLATE V.

All the drawings are by J. Henry Blake, excepting figs. 9, 11, 12 by J. H. Emerton, and figs. 1 and 15 by S. H. Scudder. All are enlarged two diameters.

Fig. 1. Etoblattina residua (2131). Cassville, W. Va.
2. Etoblattina sp. Pawtucket, R. I.
3. Etoblattina mucronata (2105). Cassville, W. Va.
4. Etoblattina exigua (2107). Cassville, W. Va.
5. Etoblattina funeraria (2108). Cassville, W. Va.
6. Etoblattina expuncta (2109). Cassville, W. Va.
7. Etoblattina jeffersoniana (194). Richmond, Ohio.
8. Etoblattina gorhami. Pawtucket, R. I.
9. Etoblattina aperta (2066). Cassville, W. Va.
10. Etoblattina clarkii. Pawtucket, R. I.
11. Etoblattina fasciata. Richmond, Ohio.
12. Etoblattina ramosa (108). Richmond, Ohio.
13. Etoblattina willsiana (176). Richmond, Ohio.
14. Etoblattina benedicta (183). Richmond, Ohio.
15. Etoblattina benedicta (178). Richmond, Ohio.



BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE VI.

EXPLANATION OF PLATE VI.

All the drawings are by Katherine Peirson Ramsay, excepting figs. 4 and 6 by J. H. Emerton, and figs. 5 and 8 by J. Henry Blake. All are magnified two diameters.

Fig. 1. Etoblattina maledicta (174). Richmond, Ohio.
2. Etoblattina maledicta (163). Richmond, Ohio.
3. Etoblattina maledicta (164). Richmond, Ohio.
4. Etoblattina funesta (107). Richmond, Ohio.
5. Etoblattina mazona. Mazon Creek, Illinois.
6. Etoblattina tenuis. Richmond, Ohio.
7. Etoblattina exsensa (161). Richmond, Ohio.
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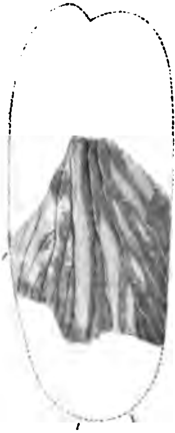
9. Etoblattina hustoni (122). Richmond, Ohio.



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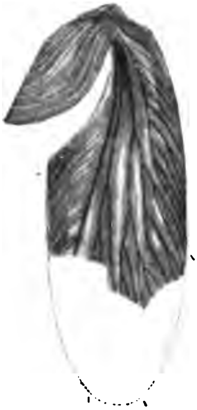

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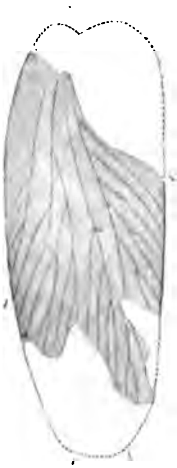

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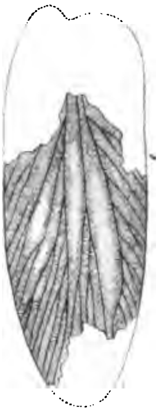

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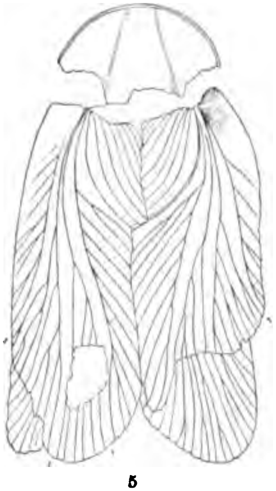

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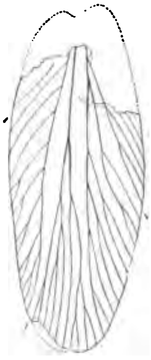

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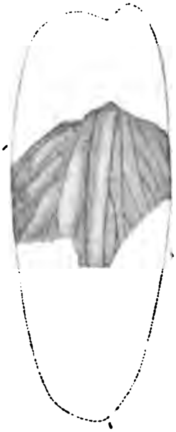

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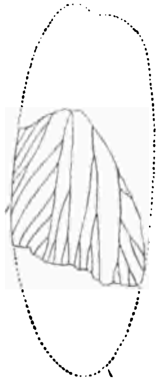

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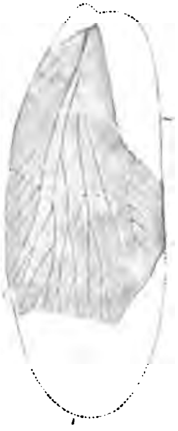

9

BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE VII.

EXPLANATION OF PLATE VII.

All the drawings are by J. Henry Blake, excepting figs. 6, 10, 14 to 17 by Katherine Peirson Ramsay, and fig. 13 by S. H. Scudder. All are magnified two diameters.

Fig. 1. Etoblattina eakiniana (2111). Cassville, W. Va.
2. Etoblattina accubita (2112). Cassville, W. Va.
3. Etoblattina expulsata (2113*a*). Cassville, W. Va.
4. Etoblattina expulsata (2113*c*). Cassville, W. Va.
5. Etoblattina gratiosa (2114). Cassville, W. Va.
6. Etoblattina macerata (2081). Cassville, W. Va.
7. Etoblattina immolata (2115*c*). Cassville, W. Va.
8. Etoblattina immolata (2115*a*). Cassville, W. Va.
9. Etoblattina mactata (2116). Cassville, W. Va.
10. Etoblattina communis (2117*h*). Cassville, W. Va.
11. Etoblattina communis (2117*c*). Cassville, W. Va.
12. Etoblattina communis (2117*o*). Cassville, W. Va.
13. Etoblattina communis (2117*a*). Cassville, W. Va.
14. Etoblattina communis (2117*e*). Cassville. W. Va.
15. Etoblattina communis (2117*g*). Cassville, W. Va.
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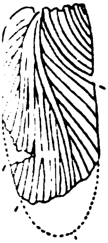
17. Etoblattina communis (2117*i*). Cassville, W. Va.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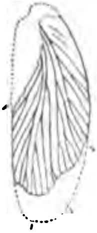
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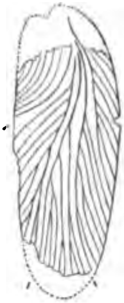
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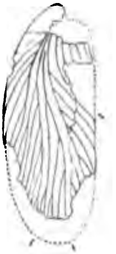
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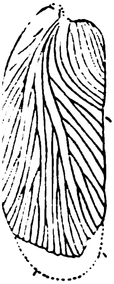
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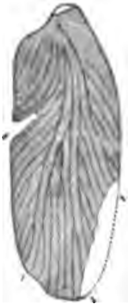
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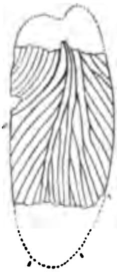
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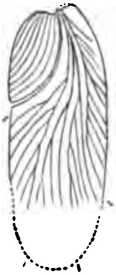
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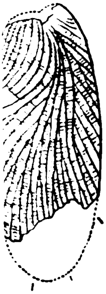
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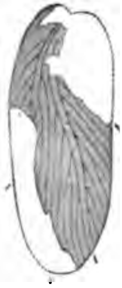
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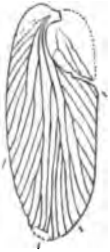
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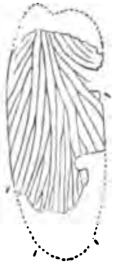
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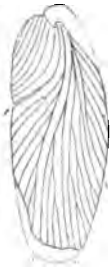
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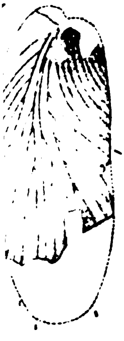
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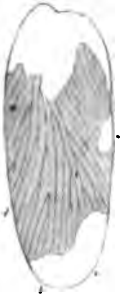
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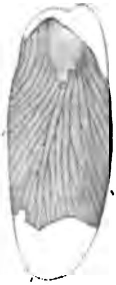
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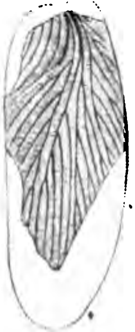

17

BLATTINARIÆ: SPECIES OF ETOBLATTINA.

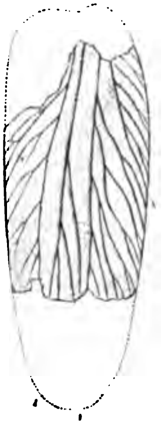
PLATE VIII.

PLATE VIII.

EXPLANATION OF PLATE VIII.

Figs. 4, 5, 7, 9, 12 are by J. Henry Blake; figs. 3, 8, 10, 11 by Katherine Peirson Ramsey, and figs. 1, 2, 6 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Etoblattina hastata (106). Richmond, Ohio.
2. Etoblattina marginata (117). Richmond, Ohio.
3. Etoblattina stipata (123). Richmond, Ohio.
4. Etoblattina exsecuta (2120). Cassville, W. Va.
5. Etoblattina arcta (2118). Cassville, W. Va.
6. Etoblattina gracilenta (114). Richmond, Ohio.
7. Etoblattina gracilenta (198). Richmond, Ohio.
8. Etoblattina angusta (2080). Cassville, W. Va.
9. Etoblattina macilenta (2121). Cassville, W. Va.
10. Etoblattina variegata (49). Richmond, Ohio.
11. Etoblattina hilliana (2070). Mazon Creek, Illinois.
12. Etoblattina prædulcis (2119). Cassville, W. Va.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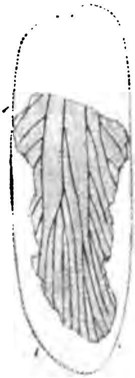
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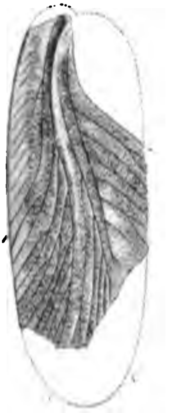
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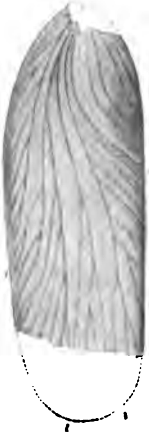
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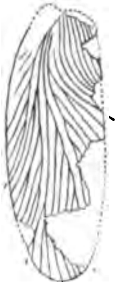
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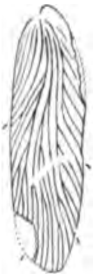
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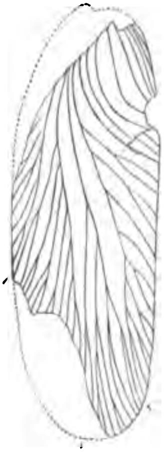
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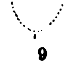
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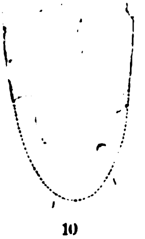
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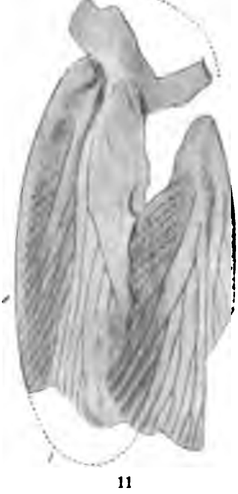
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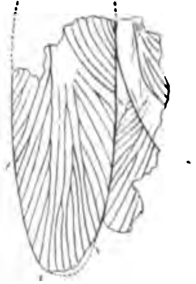

12

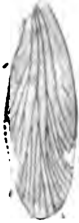
BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE IX.

EXPLANATION OF PLATE IX.

All the drawings are by J. Henry Blake, excepting figs. 2 and 14 by S. H. Scudder, and fig. 18 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Etoblattina exilis. East Providence, R. I.
2. Etoblattina rogi (2122*b*). Cassville, W. Va.
3. Etoblattina rogi (2122*a*). Cassville, W. Va.
4. Etoblattina expugnata (2085). Cassville, W. Va.
5. Etoblattina obatra (2123). Cassville, W. Va.
6. Etoblattina secreta (2125*a*). Cassville, W. Va.
7. Etoblattina secreta (2125*c*). Cassville, W. Va.
8. Etoblattina imperfecta (2124). Cassville, W. Va.
9. Etoblattina invisa (2126). Cassville, W. Va.
10. Etoblattina reliqua. Pawtucket, R. I.
11. Etoblattina latebricola (2091). East Providence, R. I.
12. Etoblattina defossa (2128). Cassville, W. Va.
13. Etoblattina occulta (2127). Cassville, W. Va.
14. Etoblattina recidiva (2129). Cassville, W. Va.
15. Gerablattina diversinervis (2141). Cassville, W. Va.
16. Gerablattina inculta (2139). Cassville, W. Va.
17. Gerablattina perita (2140). Cassville, W. Va.
18. Gerablattina apicalis (112). Richmond, Ohio.



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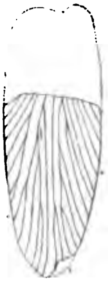

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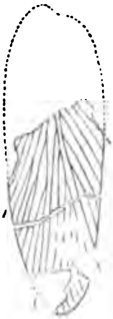

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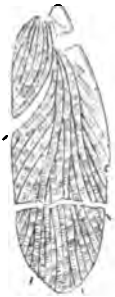

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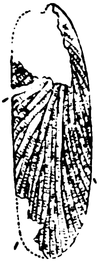

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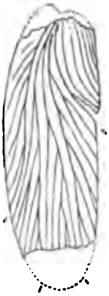

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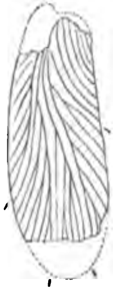

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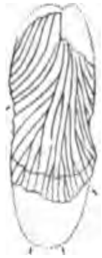

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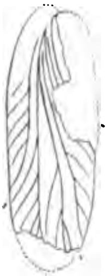

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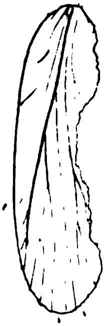

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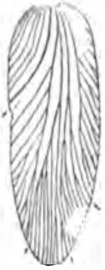

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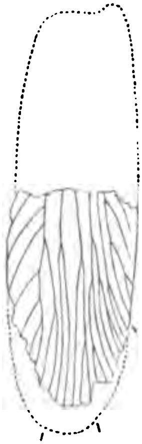

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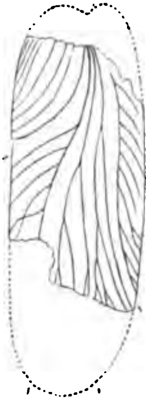

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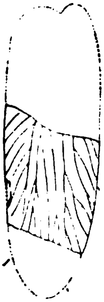

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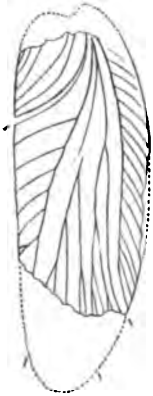

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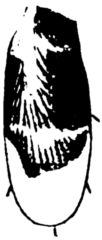

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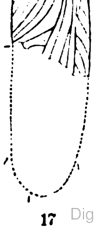

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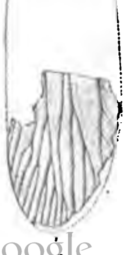


18

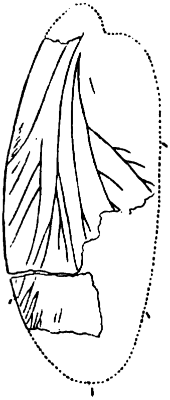
BLATTINARIÆ: SPECIES OF ETOBLATTINA AND GERABLATTINA.

PLATE X.

EXPLANATION OF PLATE X.

All the drawings are by J. Henry Blake, excepting figs. 3 and 5 by S. H. Scudder, and fig. 8 by Katherine Peirson Ramsay. All are magnified two diameters.

Fig. 1. Gerablattina richmondiana (169). Richmond, Ohio.
2. Gerablattina cassvici (2142*a*). Cassville, W. Va.
3. Gerablattina cassvici (2142*c*). Cassville, W. Va.
4. Gerablattina concinna (2077*a*). Cassville, W. Va.
5. Gerablattina concinna (2077*c*). Cassville, W. Va.
6. Gerablattina abdicata (2143). Cassville, W. Va.
7. Gerablattina scapularis. Pawtucket, R. I.
8. Gerablattina uniformis (2082*f*). Cassville, W. Va.
9. Gerablattina uniformis (2082*a*). Cassville, W. Va.
0. Gerablattina uniformis (2082*c*). Cassville, W. Va.
11. Gerablattina uniformis (2082*e*). Cassville, W. Va.
12. Gerablattina permanenta (2144). Cassville, W. Va.
13. Gerablattina permacra (2188). Cassville, W. Va.
14. Gerablattina eversa (2145). Cassville, W. Va.
15. Gerablattina deducta (2146). Cassville, W. Va.
16. Gerablattina fraterna. East Providence, R. I.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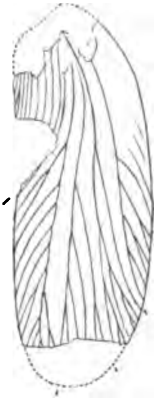
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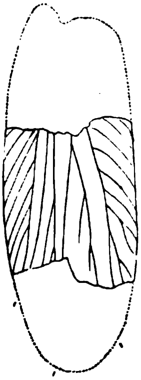
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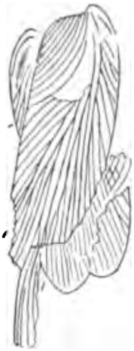
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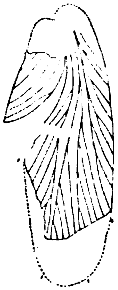
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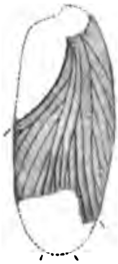
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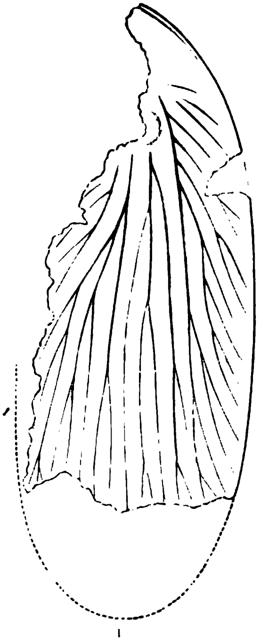
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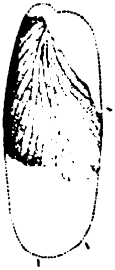
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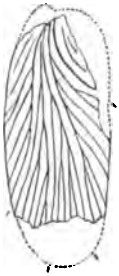
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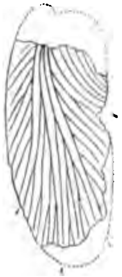
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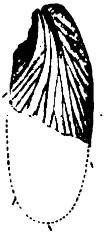
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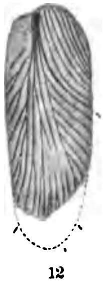
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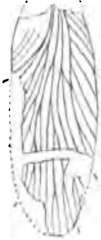
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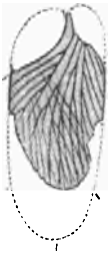
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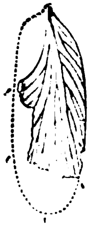
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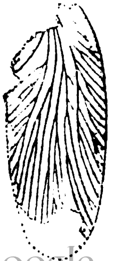

16

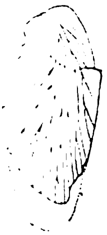
BLATTINARIÆ: SPECIES OF GERABLATTINA.

PLATE XI.

EXPLANATION OF PLATE XI.

All the drawings are by J. Henry Blake, excepting figs. 1 and 13 by S. H. Scudder, figs. 11 and 15 by Katherine Peirson Ramsay, and fig. 12 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Gerablattina radiata (2147). Cassville, W. Va.
2. Gerablattina lata (2148). Cassville, W. Va.
3. Gerablattina rotundata (2149). Cassville, W. Va.
4. Gerablattina ovata (2150). Cassville, W. Va.
5. Gerablattina minima (2183). Richmond, Ohio.
6. Oryctoblattina laqueata (2136). Kansas City, Mo.
7. Anthracoblattina americana (2137). Clinton, Mo.
8. Anthracoblattina virginiensis (2138). Cassville, W. Va.
9. Progonoblattina columbiana. Mazon Creek, Illinois.
10. Petrablattina hastata (2133). Cassville, W. Va.
11. Poroblattina ohioensis (162). Richmond, Ohio.
12. Poroblattina longinqua (111). Richmond, Ohio.
13. Poroblattina gratiosa (2134). Cassville, W. Va.
14. Poroblattina complexinervis (2135). Cassville, W. Va.
15. Poroblattina fossa (2083). Cassville, W. Va.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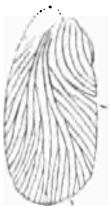
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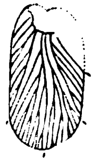
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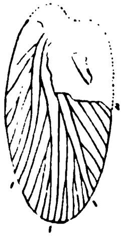
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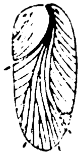
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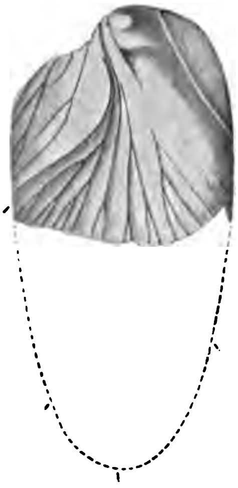
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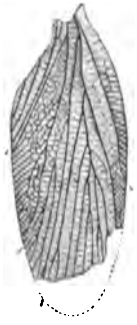
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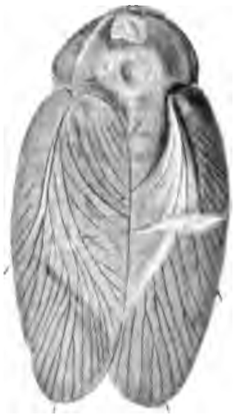
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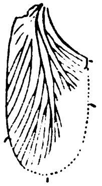
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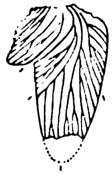
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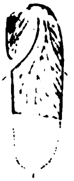
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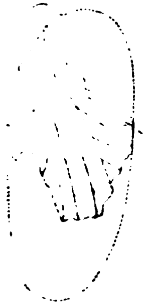
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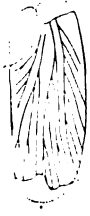
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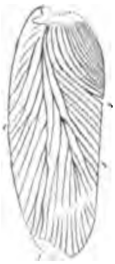
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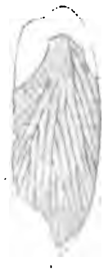

15

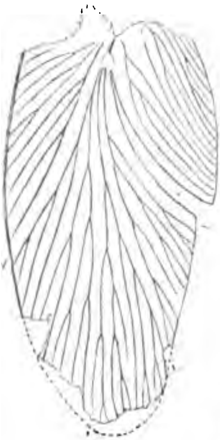
TINARIÆ: SPECIES OF GERABLATTINA, ORYCTOBLATTINA, ANTHRACOBLATTINA, PROGONOBLATTINA, PETRABLATTINA, AND POROBLATTINA.

PLATE XII.

EXPLANATION OF PLATE XII.

All the drawings are by J. Henry Blake, excepting fig. 5 which is by Katherine Peirson Ramsay. All are magnified two diameters, excepting figs. 8–11 which are of natural size.

Fig. 1. Etoblattina deanensis (2132*b*). Forest of Dean, England.
2. Etoblattina sp. East Providence, R. I.
3. Etoblattina deanensis (2132*c*). Forest of Dean, England.
4. Etoblattina sp.; hind wing. Cranston, R. I.
5. Blattina sp.; hind wing (2038). Mazon Creek, Illinois.
6. Etoblattina sp.; hind wing (2084*a*). Cassville, W. Va.
7. Etoblattina sp.; hind wing (2084*b*). Cassville, W. Va.
8. Body of cockroach; right-side view (4941). Illinois. (See p. 25.)
9. The same; ventral surface.
10. The same; left-side view.
11. The same; dorsal surface.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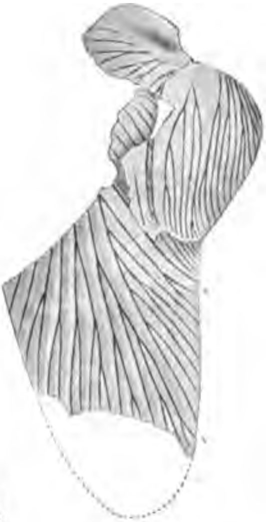
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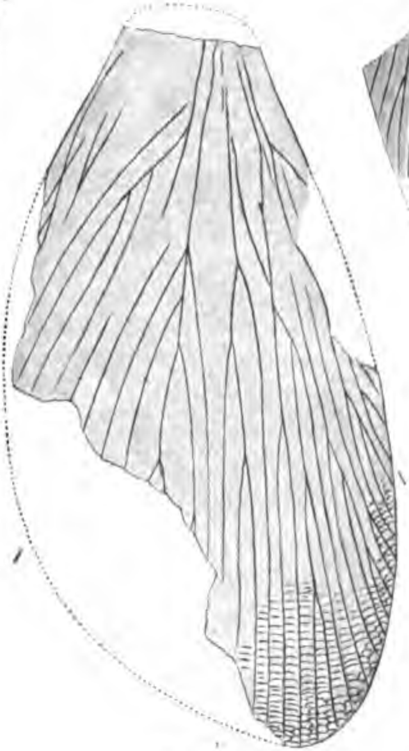
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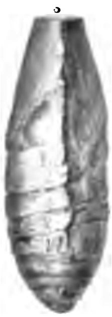
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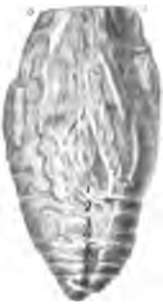
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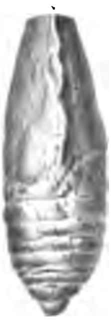
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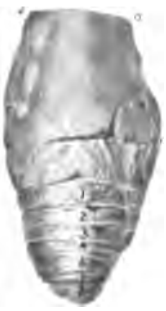
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THE
CONSTITUTION OF THE SILICATES

BY

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JUL 189

THE CONSTITUTION OF THE SILICATES.

BY F. W. CLARKE.

CHAPTER I.

INTRODUCTION.

In the solid crust of the earth the silicates are by far the most important constituents. They form at least nine-tenths of the entire known mass, and comprise practically all of the rocks except the sandstones, quartzites, and carbonates; even these exceptions are commonly derivatives of the silicates, which break up under various conditions, yielding simpler bodies of their own class, together with free silica and limestone. From a geological point of view, therefore, the silicates are of fundamental importance, and a study of their inner constitution may be reasonably expected to shed light upon many serious problems. For example, every primitive rock or eruptive mass contains an aggregation of silicates, each one of which is capable of undergoing chemical change in accordance with limitations imposed by the structure of its molecules. When these changes take place, secondary compounds, alteration products, are formed, and in time the rock becomes transformed into new substances, quite unlike those which originally existed. A knowledge of the processes which thus occur should be applicable to the study of the rocks, and should ultimately render it possible so to investigate a metamorphosed mass as to clearly indicate its origin. These processes are dependent upon chemical structure, and the study of this with regard to the silicates is the purpose of the present memoir.

From the standpoint of the chemist the problem under consideration is one of great importance, but also of great difficulty. Some of the difficulty is real, some only apparent. At first sight the natural silicates appear to be compounds of great complexity; but this difficulty becomes much less serious after careful examination. Few of the natural silicates exist in even an approximately pure condition; many that seem fresh have undergone traces of alteration; isomorphous mixtures are exceedingly common; and much confusion is due to defective analyses. By multiplied observations these difficulties can be eliminated from the problem, but others yet remain to be disposed of. The organic chemist, to whom most of our knowledge of chemical structure is due, deals mainly with bodies of known molecular weight, which can be measured by the density of a vapor or by cryoscopic methods. To the mineral chemist such knowledge is not available, for the compounds which interest him are neither volatile nor soluble, and their molecular weights can only be inferred. The simplest empirical formula of a silicate is not necessarily its true formula; the latter may be a multiple or polymer of the former; and here we find a difficulty which is at present almost insuperable. Strong evidence can be brought to bear upon this side of the question, but it is only partial evidence and not finally conclusive. The case, however, is by no means hopeless, for even the partial solution of a problem is better than no solution at all. An approximation is some gain, and it is possible so to investigate the constitution of the silicates as to bring many relations to light, developing formulæ which express those relations and indicate profitable lines for future research.

The problem is open to attack from several points of view, and various methods of investigation can be brought to bear upon it. First, of course, the empirical formula of each silicate must be definitely ascertained, which involves the discussion of sufficiently numerous analyses and the elimination of possible errors due to impurity, alteration, and isomorphous admixtures. In this work the microscope renders important service to the analyst, and makes his results much more certain. By the aid of the microscope many supposed mineral species have been proved to be mixtures, and the problem of the silicates has been thereby simplified. Indeed, the final outcome of such investigation generally indicates, for any given natural silicate, simplicity of composition; and this is what should be expected. These compounds are, as a rule, exceedingly stable salts, while complex substances are commonly characterized by instability. The mineral silicates are formed in nature under conditions of high temperature or are deposited from solutions in which many reactions are simultaneously possible, and these circumstances are strongly opposed to any great complications of structure. Furthermore, they are quite limited in number, only a few hundred at most being known; whereas, if complexity were the rule among them, slight variations in origin should produce corresponding variations in character, and millions of different minerals would be generated. That few variations exist is presumptive evidence that only few are possible, and hence simplicity of constitution is reasonably to be inferred. In fact, we find the same small range of mineral species occurring under the same associations in thousands of widely separated localities; a few typical forms containing a few of the commonest metals being almost universally distributed. The longer the evidence is considered, the stronger the argument in favor of simple silicate structures becomes.

Having established the empirical formula of a silicate, its physical properties may next be considered; and of these the crystalline form and the specific gravity are the most important. From identity of form, or complete isomorphism between two species, we infer similarity of chemical structure, and the inferences thus drawn are often of the highest value. On the other hand, dissimilarity of form and identity of composition indicate isomerism, as for example in the cases of andalusite and kyanite; and here again we secure evidence which bears directly upon the study of chemical constitution. From the specific gravity the so-called molecular volume of a species may be computed, and that datum gives suggestions as to the relative condensation of a molecule in comparison with others of similar empirical composition. For instance, leucite and jadeite are empirically of similar type; but the latter has by far the greater density, together with superior hardness. It is, therefore, presumably more complex than leucite, and this supposition must be taken into account in considering its ultimate formula.

From what may be called the natural history of a mineral, still another group of data can be drawn, relating to its genesis, its constant associations, and its alterability. In this connection pseudomorphs become of the utmost interest, and, properly studied, shed much light upon otherwise obscure problems. An alteration product is the record of a chemical change, and as such has weighty significance. The decomposition of spodumene into eucryptite and albite, the transformation of topaz into mica, and many like occurrences in nature, are full of meaning with reference to the problem now under consideration. Just here, however, great caution is necessary. Mineralogical literature is full of faulty records regarding alterations, and many diagnoses need to be revised. Pseudomorphs have been named by guesses, based upon their external appearance, and often a compact mica has been called steatite or serpentine. In every case an alteration product should be identified with extreme care, both by chemical and by microscopical methods; for without such precautions there is serious danger of error. In each instance the supposed fact must be scrupulously verified.

Closely allied to the study of natural alterations is their artificial production in the laboratory. The transformation of leucite into analcite, and of analcite back into leucite, is a case in point, and the admirable researches of Lemberg furnish many other examples. Work of this character is much less difficult than was formerly supposed, and its analogy to the methods of organic chemistry renders its results highly significant. Atoms, or groups of atoms, may be split off from a molecule and replaced by others, and the information so gained bears directly upon the question of chemical structure. With evidence of this sort relations appear which could not otherwise be recognized, and these relations may be closely correlated with observations of natural occurrences.

Evidence of the same or similar character is also furnished by the thermal decomposition of silicates, a line of investigation which has been successfully followed by several investigators. Thus garnet, when fused, yields anorthite and an olivine; natrolite gives nepheline; talc, upon ignition, liberates silica; and the prolonged heating of ripidolite produces an insoluble residue having the empirical composition of spinel. All of these facts have relevancy to the problem of chemical constitution, and their number could easily be enlarged by experiment. As yet the field has been barely scratched upon the surface; upon deeper cultivation a goodly crop may be secured.

The artificial synthesis of mineral species, with the allied study of crystalline slags and furnace products, furnishes still more evidence of pertinent utility. But, here again, caution is needed in the interpretation of results. A compound may be produced in various ways, and it does not follow that the first method which is successful in the laboratory is the method pursued by nature in the depths of the earth. The data yielded by synthesis are undoubtedly helpful in the determination of chemical constitution, but they furnish only a small part of the proof needed for complete demonstration, and their applicability to geological questions is limited in the extreme. For the latter purpose they are only suggestive, not final.

Suppose now that the empirical formula of a silicate has been accurately fixed, and that a mass of data such as I have indicated are available for combination with it. Suppose the physical properties to be determined, the natural relations known, the alteration products observed, its chemical reactions and the results of fusion ascertained; what then? It still remains to combine these varied data into one expression which shall symbolize them all, and that expression will be a constitutional formula. To develop this, the established principles of chemistry must be intelligently applied, with due regard to recognized analogies. The grouping of the atoms must be in accord with other chemical knowledge; they must represent known or probable silicic acids; and any scheme which fails to take the latter consideration into account is inadmissible. Not merely composition, but function also is to be represented, and the atomic linking which leaves that disregarded may be beautiful to see, but is scientifically worthless. A good formula indicates the convergence of knowledge; if it fulfills that purpose it is useful, even though it may be supplanted at some later day by an expression of still greater generality. Every formula should be a means toward this end, and the question whether it is assuredly final is of minor import. Indeed, there is no formula in chemistry to-day of which we can be sure that the last word has been spoken.

In the development of constitutional formulæ for the silicates it sometimes happens that alternatives offer between which it is difficult to decide. Two or more distinct expressions may be possible, with the evidence for each so strong that neither can be accepted or abandoned. In such cases nothing can be done but to state the facts and await the discovery of new data, to which, however, the formulæ themselves may give clews. This sort of uncertainty is peculiarly common among the hydrous silicates, and often arises from the difficulty of discriminating between water of crystallization, so called, and constitutional hydroxyl. If in every silicate analysis the state of hydration were carefully examined, the conditions of dehydration being observed at different temperatures, much of this obscurity would be avoided.

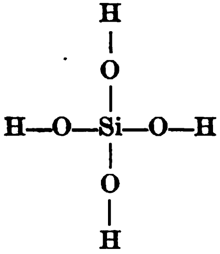
In discriminating between rival formulæ, one rule is provisionally admissible. Other things being equal, a symmetrical formula is more probable than one which is unsymmetrical. Symmetry in a molecule conduces to stability; most of the silicates are exceedingly stable; and hence symmetry is to be expected. This rule has presumptive value only, as an aid to judgment, and can not be held rigidly. It expresses a probability, but gives no proof. In a problem like that of the silicates, however, even a suggestion of this kind may render legitimate assistance.

CHAPTER II.

THE THEORY OF THE SILICATES.

If all of the silicates were salts of a single silicic acid, the problem of their constitution would be relatively simple; but this is not the case. Many silicic acids are theoretically possible, and several of them have representatives in the mineral kingdom, although the acids themselves, as such, are not known. Their nature must be inferred from their salts, and especially from their ethers, and this side of the problem is the first to be considered.

Since silicon is quadrivalent, its ortho acid is necessarily represented by one atom of the element united with four hydroxyl groups, thus—$Si(OH)_4$, or, structurally:



$$\begin{array}{ccccc} & & H & & \\ & & | & & \\ & & O & & \\ & & | & & \\ H—O & — & Si & — & O—H \\ & & | & & \\ & & O & & \\ & & | & & \\ & & H & & \end{array}$$

To this acid, orthosilicic acid, the normal silicic ethers and many common minerals correspond. Its normal salts, reduced to their simplest expressions, may be typically represented as follows:

Types.	*Examples.*
$R^{i}_4SiO_4$	$(C_2H_5)_4SiO_4$
$R^{ii}_2SiO_4$	Mg_2SiO_4
$R^{iii}_4(SiO_4)_3$	$Al_4(SiO_4)_3$
$R^{iv}SiO_4$	$ZrSiO_4$

Any silicate in which the oxygen atoms outnumber the silicon atoms by more than four to one, as for example the compound Al_2SiO_5, must be regarded as a basic salt.

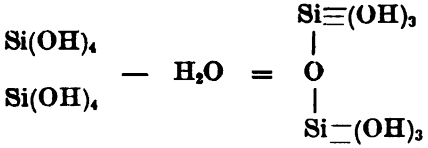
By elimination of water orthosilicic acid may be conceived as yielding, first, metasilicic acid, H_2SiO_3, and, secondly, the anhydride, SiO_2, thus:

$$Si(OH)_4 \qquad O=Si=(OH)_2 \qquad O=Si=O$$

Corresponding to metasilicic acid many salts are known, but as yet no ethers have been certainly obtained. The ethers first described by Ebelmen were supposed to be metasilicates, but all recent investigations have shown them to be ortho compounds, possibly more or less impure.' Troost and Hautefeuille, however, have described an ether having the formula, $(C_2H_5)_8Si_4O_{12}$, which is a polymer of a metasilicate; but its true nature has not been determined. The simplest formulæ for typical metasilicates are as follows:

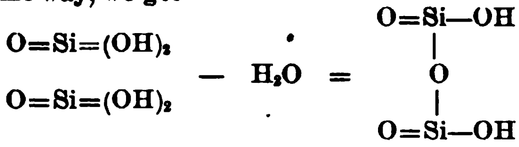
Types.	*Examples.*
$R^{i}_2SiO_3$	Na_2SiO_3
$R^{ii}SiO_3$	$MgSiO_3$
$R^{iii}_2(SiO_3)_3$	$Al_2(SiO_3)_3$*
$R^{iv}(SiO_3)_2$	$Zr(SiO_3)_2$*

By eliminating a molecule of water from two molecules of orthosilicic or metasilicic acid, a disilicic acid may be produced. From orthosilicic acid we have



$$\begin{array}{l}Si(OH)_4\\ \\ Si(OH)_4\end{array} - H_2O = \begin{array}{c}Si\equiv(OH)_3\\ |\\ O\\ |\\ Si\equiv(OH)_3\end{array}$$

or, $H_6Si_2O_7$; a sexbasic acid of which several ethers have been obtained. It is, therefore, a well-established acid, and a number of silicates appear to be salts of it. It may be called diorthosilicic acid. From metasilicic acid, in the same way, we get



$$\begin{array}{l}O=Si=(OH)_2\\ \\ O=Si=(OH)_2\end{array} - H_2O = \begin{array}{c}O=Si-OH\\ |\\ O\\ |\\ O=Si-OH\end{array}$$

or dimetasilicic acid, $H_2Si_2O_5$. No ethers of this acid are known, but among its salts are the minerals petalite, milarite, ptilolite, and mordenite.

By a similar process, that is, the elimination of water from three or four molecules of orthosilicic acid, a series of tri- and tetrasilicic acids may be theoretically developed. These higher acids would present many possibilities for isomerism, and with their long chains of atoms would presumably be unstable. At all events, with a single exception, it is unnecessary to consider them in order to account for the natural silicates. The one exception is the tetrabasic acid $H_4Si_3O_8$, which appears most notably in eudidymite, the feldspars, the micas, and the scapolite group. The feldspars of this type, however, albite and orthoclase, are represented by Groth as mixed salts of two other silicic acids, when $Si_2O_5+SiO_3=Si_3O_8$; so that the trisilicic acid in question can be left out of consideration. But a general view of the whole field seems to point to its existence; at least greater simplicity is secured by retaining it in the scheme of silicic acids; and that policy will be followed throughout this memoir. As opposed to Groth's view, we have also to consider the theory of Becker* that metasilicates may be really mixtures or compounds of ortho- and trisilicates, with $H_4SiO_4 + H_4Si_3O_8 = 4H_2SiO_3$. This theory may easily be pushed to an extreme, for the weight of evidence shows that true metasilicates exist; but in many cases it has real significance; that is, mixed salts are known having pseudometasilicate ratios, and these are most simply explained by Becker's theory, which, in the case of the micas, had been independently developed by myself. As to the constitution of trisilicic acid, we have no positive evidence, and at least two independent structures are conceivable, thus:

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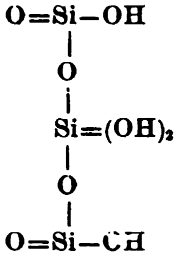
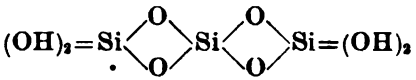
* Salts not actually known, but theoretically possible.



and



The first of these formulæ has the closer analogy with the formulæ of the other silicic acids, and is, therefore, in default of evidence, to be preferred. Furthermore, it indicates possibilities of isomerism, such as we find in the case of orthoclase and microcline, a consideration which is well worth bearing in mind.

So far, then, there are five silicic acids whose salts occur in the crust of the earth. They are:

Orthosilicic acid	H_4SiO_4
Metasilicic acid	H_2SiO_3
Diorthosilicic acid	$H_6Si_2O_7$
Dimetasilicic acid	$H_2Si_2O_5$
Trisilicic acid	$H_4Si_3O_8$

and unless we admit the possible polymerization of metasilicic acid, as suggested by Troost and Hautefeuille's ether, no others need be invoked in order to account for the facts which are now available. The possibility of other silicic acids is an entirely distinct question.

If the natural silicates were simple normal salts of the five silicic acids the problem of their constitution would not be difficult. But relatively few of the known species are of this description; the greater number are double salts, and even triple replacements are not uncommon. Furthermore, there are acid and basic salts to be interpreted, and the latter class offers the most serious difficulties. A basic metasilicate, for example, may have the same empirical composition as an orthosilicate; so that its ratios, studied apart from other evidence, tell nothing as to the class in which it belongs. Take for instance the formula Al_2SiO_5, which represents the composition of three distinct minerals, andalusite, sillimanite, and kyanite, and it admits of several different structural expressions. As a basic metasilicate it may be written

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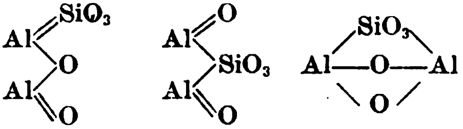
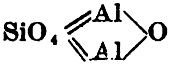
*Am. Jour. Sci., (3) XXXVIII, p. 154, 1889.



and as an orthosilicate it becomes either

$O{=}Al{-}SiO_4{\equiv}Al$, or



If its molecular weight is a multiple of that indicated by the formula Al_2SiO_5, then the possibilities of isomeric structure become still more complicated. Its composition alone does not give its molecular structure, and other evidence, as shown in the introduction to this memoir, must be brought to bear before the problem can be even approximately solved. This evidence is sometimes available, sometimes not, as will be seen in the systematic discussion of the individual species later.

A hasty glance over the entire field of the natural silicates will show, first, that many of them are most easily interpreted as orthosilicates, and, secondly, that by far the greater number are salts of aluminum. As regards both abundance and variety the aluminous silicates outrank all the others, and from the wide range of composition which they exhibit we can obtain clews to their constitution. In other words, they furnish the most evidence, and some of it is of the highest import. Their relations to one another are oftentimes clear and unmistakable, so that the constitution of one salt is the key to that of a second; and thus generalization becomes possible.

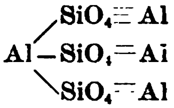
If we consider first the orthosilicates of aluminum, one general relation is easily made apparent. By a general relation I do not mean a universal relation, for exceptions are possible; but only that many of the salts are connected by a simple regularity, or even a law. To make this apparent it is necessary to recognize the fact that aluminum is now properly regarded as a trivalent metal, its formerly supposed quadrivalency being no longer admissible. Formulæ in which aluminum appears as a tetrad are not valid; and ferric iron, which replaces aluminum, follows the same rule. This point has been made clear by the vapor density and cryoscopic investigations of recent years, and is sustained also by the position of aluminum in the periodic classification of the elements.

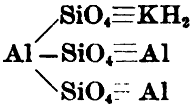
This much admitted, the general relation of which I have spoken is as follows: Many, perhaps all, of the orthosilicates of aluminum are most simply represented as substitution derivatives of the normal salt $Al_4(SiO_4)_3$. To illustrate this rule for present purposes, the following examples will suffice:

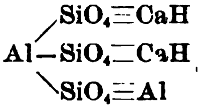
Aluminum orthosilicate	$Al_4(SiO_4)_3$
Eucryptite	$Al_3(SiO_4)_3Li_3$
Nephelite	$Al_3(SiO_4)_3Na_3$
Kaliophilite	$Al_3(SiO_4)_3K_3$
Muscovite	$Al_3(SiO_4)_3KH_2$
Paragonite	$Al_3(SiO_4)_3NaH_2$
Andalusite	$Al_3(SiO_4)_3(AlO)_3$
Topaz	$Al_3(SiO_4)_3(AlF_2)_3$
Natrolite	$Al_2(SiO_4)_3Na_2H_4$
Biotite	$Al_2(SiO_4)_3MgKH$
Grossularite	$Al_2(SiO_4)_3Ca_3$
Prehnite	$Al_2(SiO_4)_3Ca_2H_2$
Phlogopite	$Al(SiO_4)_3Mg_3KH_2$

These formulæ express not only the composition of the minerals, but also many facts concerning their relations, such as their association, their alteration one into another, and so on. Thus, topaz and andalusite are crystallographically akin; both minerals, as well as others in the series, alter easily into muscovite, and these facts become intelligible in the light of the formulæ given. In the use of the formulæ, however, one possible misconception must be avoided. They express a relationship of constitution, but do not imply that Nature first generated the normal salt and then actually developed the other compounds from it. To emphasize this point an analogy may be drawn from organic chemistry. Alizarin, derived constitutionally from anthracene, was originally obtained from a glucoside contained in madder root. But nobody supposes that the madder plant took anthracene as a starting point from which to produce the dye. The constitutional or structural derivation is one thing; the natural origin is quite another.

Whether aluminum orthosilicate as such exists in nature is still a matter of doubt. The rare mineral xenolite has the composition $Al_4(SiO_4)_3$, but it needs further study before its integrity as a species can be fully recognized. At present the weight of evidence seems to be in its favor, but its occurrence is that of a secondary mineral. Among the products of primitive magmas it has not been observed. As regards its ultimate constitution or chemical structure, that question must also be left open. It can be written structurally in several ways; either with each aluminum atom linked with all the SiO_4 groups or with only one atom so connected. In a sense this problem is analogous to that offered by the benzene ring, prism, or nucleus, a conception of which the utility is fully recognized, in spite of outstanding uncertainties. For practical purposes, that is, for the coördination of known facts, expressions like the following are sufficient:







These expressions indicate the observed replaceability of aluminum atoms by other atoms or groups, and have no ulterior significance. So long as their limitations are kept in mind they are useful, but beyond this it would be unreasonable to go. With prolonged discussion and more evidence we may get a deeper insight into the nature of the fundamental molecule; at present, speculation concerning it would be premature. The relations expressed are clear, no matter what others may be revealed in the future. As a working hypothesis, the conception of substitution from a normal salt may be applied to many nonaluminous silicates, as in the magnesian series, the silicates of quadrivalent metals, and so on. These points will be developed in subsequent chapters. In the systematic discussion I shall begin with the orthosilicates, starting with those of aluminum, for the reason that they show most clearly the evidence relative to structure. In a classification of the silicates the starting point would be different, but this is not a classification. The trisilicates will be considered with the orthosilicates, for reasons which are obvious. In the feldspar, zeolite, and mica groups the ortho- and trisilicates can not well be separated.

CHAPTER III.

THE ORTHOSILICATES OF ALUMINUM.

I. THE NEPHELITE TYPE.

If, in accordance with the ideas developed in the preceding chapter, we start out from the normal salt $Al_4(SiO_4)_3$, the first and simplest replacement possible is that of a single aluminum atom by three monads, giving a compound of the general formula $Al_3(SiO_4)_3R'_3$. This formula represents several well-known minerals, and I propose to designate it as the *nephelite type.* At first sight it seems to be reducible to the simpler expression $R'AlSiO_4$, but that expression, as will be seen later, does not indicate all the known relations of the group.

The first three representatives of this type are as follows:

Eucryptite	$Al_3(SiO_4)_3Li_3$
Nephelite	$Al_3(SiO_4)_3Na_3$
Kaliophilite	$Al_3(SiO_4)_3K_3$

These species are all hexagonal, are nearly equal in density, and all gelatinize with hydrochloric acid. The second and typical member of the series has been made synthetically, and is then found to have the composition indicated by the formula. The natural nephelite, however, has a composition which is more exactly represented by the complex formula $R'_8Al_8Si_9O_{34}$, in which a little potassium appears among the components of R′, while there is an excess of silica over the amount required by theory. The potassium is doubtless due to an isomorphous admixture of kaliophilite, and the excess of silica can be explained by the presence of a salt isomeric with albite and having the composition $Al_3(Si_3O_8)_3Na_3$. This replacement of SiO_4 by Si_3O_8 appears to be common among the silicates, and its recognition clears up many discrepancies. In this case one molecule of the trisilicate commingled with fifteen of the ortho-salt will produce the divergence from normal composition shown in the analyses of natural nephelite.

By direct alteration nephelite passes easily into two zeolitic minerals, having the subjoined formulæ:

Hydronephelite	$Al_3(SiO_4)_3Na_2H.3H_2O$
Natrolite	$Al_2(SiO_4)_3Na_2H_4$

In natrolite, two atoms of aluminum have been replaced by $R'_6 = Na_2H_4$, and this species, with others of like origin, falls therefore into another group. Still it is desirable now to call attention to the fact, observed by Doelter,[*] that natrolite on fusion yields nephelite. The connection between the two species is unmistakable.

Eucryptite and nephelite both alter with great ease into muscovite, a potassium salt of which paragonite is the sodium equivalent. Furthermore, C. and G. Friedel,[†] by heating finely divided muscovite to 500° in a solution of alkali, obtained nephelite in crystals. From this evidence the formulæ of muscovite and paragonite become directly related to those of the nephelite series, thus:

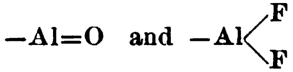
Nephelite .... $Al_3(SiO_4)_3Na_3$
Muscovite .... $Al_3(SiO_4)_3KH_2$
Paragonite .... $Al_3(SiO_4)_3NaH_2$

Physically, the two micas have no resemblance to nephelite, being different in form, slightly denser, and refractory toward acids. The relationship is purely one of chemical type, and is established by the fact of alteration from one into another.

Through muscovite a connection is recognizable between the foregoing species and the two minerals andalusite and topaz, whose simplest formulæ, tripled, may be written as follows:

Topaz .... $Al_3(SiO_4)_3(AlF_2)_3$
Andalusite .... $Al_3(SiO_4)_3(AlO)_3$

Here we encounter the evidently univalent atomic groups

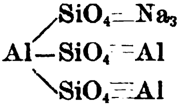


$$-\mathrm{Al}=\mathrm{O} \quad \text{and} \quad -\mathrm{Al}{<}^{\mathrm{F}}_{\mathrm{F}}$$

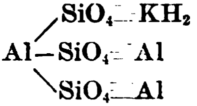
both of which play an important part in various other minerals. The two species, topaz and andalusite, are closely allied crystallographically. They have sensibly identical molecular volumes, and both undergo alteration into muscovite mica. In topaz, as shown by the investigations of Penfield and of Jannasch, hydroxyl commonly replaces a part of the fluorine; hydroxyl and fluorine being clearly isomorphous. The formula given is that of normal topaz, entirely free from alteration.

To sum up, we have now eight definite species represented by the fundamental type $Al_3(SiO_4)_3R'_3$, the first substitution from the normal orthosilicate of aluminum. Leaving hydronephelite on one side, because of its water of crystallization, the remaining seven species fall into three subtypes, as follows:

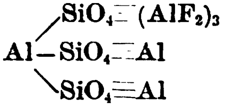
Nephelite.



Muscovite.



Topaz.



symbols which clearly indicate the known chemical relations between the several minerals. In five of the eight examples the simplest possible formulæ have been tripled, for otherwise the relationships which exist could not be structurally shown. The correctness of this procedure will appear still more definitely in the consideration of the groups which follow.

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[*] Allgem. Chem. Mineralogie, p. 183.

[†] Bull. Soc. Min., XIII, p. 129, 1890.

The species sillimanite is isomeric with andalusite, but the structural character of the isomerism is not clear. The minerals kornerupine and kryptotile, which will be considered later, are possibly also representatives of the nephelite type.

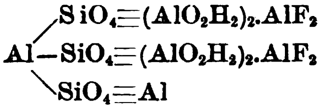
II. THE GARNET-BIOTITE TYPE.

By this title I propose to designate the second series of derivatives from the normal salt $Al_4(SiO_4)_3$, in which two atoms of aluminum have been replaced. The general formula of the type, obviously, is $Al_2(SiO_4)_3R'_6$, and in this series bivalent elements or radicles frequently appear. In natrolite, $R'_6=Na_2H_4$; in biotite, $R'_6=R''_2R'_2$; and in garnet R'_6 are entirely replaced by R''_3. There are, therefore, three subtypes to consider; one in which all the replacing atoms are univalent, one in which all are bivalent, and one intermediate between the other two.

Under the first subtype three species seem definitely to occur, viz:

Natrolite	$Al_2(SiO_4)_3Na_2H_4$
Dumortierite	$Al_2(SiO_4)_3(AlO)_6$
Zunyite	$Al_2(SiO_4)_3R'_6$*

Natrolite, as we have already seen, may be directly derived from nephelite by alteration. Dumortierite is analogous to andalusite, and, like the latter, is orthorhombic. In zunyite R'_6 is composed of the groups $-Al=F_2$, $-Al=Cl_2$, and $-Al=(OH)_2$, with possibly a little $-Al=O$, and the mineral thus seems to be chemically related to dumortierite in the same way that topaz is related to andalusite. But topaz and andalusite have crystallographic analogy, while zunyite, being isometric, is quite unlike its chemical congeners. The species evidently needs further study, but at present, if we unite the chlorine in it with the fluorine, it may be provisionally represented by the expression



$$Al\begin{cases} SiO_4\equiv(AlO_2H_2)_2.AlF_2 \\ -SiO_4\equiv(AlO_2H_2)_2.AlF_2 \\ SiO_4\equiv Al \end{cases}$$

This formula expresses the facts which are now available, but is not conclusive. Its isometric character, however, helps to connect zunyite with the garnet and sodalite groups, as has been shown by Brögger.†

In the second subtype, when R'_6 is partly composed of bivalent and partly of univalent atoms, two species may be placed, thus:

Prehnite	$Al_2(SiO_4)_3Ca_2H_2$
Biotite	$Al_2(SiO_4)_3Mg_2HK$

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* Groth's formula, generalized.

† Zeit. Kryst. Min., XVIII, p. 209.

Possibly the tetragonal sarcolite, which has the general formula of a garnet with the lime partly replaced by soda, may fall here also; but the analyses of this mineral are unsatisfactory, and its relations are still uncertain. Biotite will be more fully considered in the special chapter devoted to the mica group. Prehnite, according to Doelter,* decomposes on fusion, yielding the same products as garnet.

Under the third subtype of this series we find the garnet group itself, together with epidote and several related species. The sodalite group is also akin to garnet and to the second subtype, and will be considered in this connection a little later. Under the generic term garnet several species are included, all being isometric and strictly isomorphous, in which magnesium, calcium, and ferrous iron replace one another, while chromium, aluminum, and ferric iron are also equivalent terms. Thus we have:

Grossularite	$Al_2(SiO_4)_3Ca_3$
Pyrope	$Al_2(SiO_4)_3Mg_3$
Almandite	$Al_2(SiO_4)_3Fe''_3$
Spessartite	$Al_2(SiO_4)_3Mn_3$
Andradite	$Fe_2(SiO_4)_3Ca_3$
Ouvarovite	$Cr_2(SiO_4)_3Ca_3$

To these may be added schorlomite, a garnet in which titanium occurs both as part of the acid, that is, with TiO_4 replacing SiO_4, and also as Ti''' among the triad bases, equivalent to aluminum, The monoclinic partschinite, isomeric with spessartite, also falls into this group.

In the epidote group, at least four species appear, one, zoisite, being orthorhombic, while the other three are monoclinic. These species are characterized by the bivalent group of atoms $=\dot{A}l-OH$, thus:

Zoisite	$Al_2(SiO_4)_3Ca_2(AlOH)$
Epidote, *a*	$Al_2(SiO_4)_3Ca_2(AlOH)$
Epidote, *b*	$Fe_2(SiO_4)_3Ca_2(FeOH)$
Piedmontite	$(AlMn)_2(SiO_4)_3Ca_2(AlOH)$
Allanite	$(AlCeFe)_2(SiO_4)_3(CaFe)_2(AlOH)$

or, in general, as compared with garnet,

Garnet	$R'''_2(SiO_4)_3R''_3$
Epidote	$R'''_2(SiO_4)_3R''_2(R'''OH)$

The facts that garnet alters into epidote and that the two minerals are often associated give emphasis to the formulæ. For epidote, however, an alternative formula is possible, in which the hydroxyl is supposed to be united with calcium rather than with aluminum. But epidote is a peculiarly stable mineral, while the group —Ca—OH would imply instability and easy alteration. The alternative formula, therefore, is improbable, although it would ally epidote more easily with anorthite, which is a product of its fusion.

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* Allgem. Chem. Mineralogie, p. 183.

Although garnet, as a rule, is unattacked by acids, and epidote is only in part decomposable, both species are so broken up by strong ignition as to be readily acted upon by hydrochloric acid, with separation of gelatinous silica. According to Doelter and Hussak,* garnet yields upon fusion sometimes anorthite and an olivine; or meionite, augite, and olivine; or melilite and anorthite; and occasionally spinel. Epidote, says Doelter,† yields lime-augite and anorthite, and prehnite behaves like garnet. These facts indicate analogies between the several species named, but are not easy of complete interpretation. The different products observed may be due in part to a direct splitting up of the original insoluble mineral into soluble species like anorthite and a lime-olivine, and in part to secondary reactions taking place during the prolonged fusion and cooling of the resultant magma. In other words, two sets of phenomena are probably involved in the observations, and it is impossible at present to distinguish between them. The first set alone is immediately relevant to the constitutional question now before us.

In the four species sodalite, haüynite, nosite, and lazurite we have a group of minerals which Brögger has classified as alkali garnets.‡ Like garnet, they are all isometric, and they are characterized by the presence of the bivalent groups $=Al-Cl$, $=Al-SO_4-Na$, and $=Al-S-S-S-Na$. There are also artificial products, ultramarines, in which the groups $=Al-S-S-Na$ and $=Al-S-Na$ appear. Adopting Brögger's formulæ, which are preferable to those formerly proposed by myself,§ these species may be written as follows:

Sodalite	$Al_2(SiO_4)_3Na_4(AlCl)$
Haüynite	$Al_2(SiO_4)_3Na_2Ca(AlSO_4Na)$
Nosite	$Al_2(SiO_4)_3Na_4(AlSO_4Na)$
Lazurite	$Al_2(SiO_4)_3Na_4(AlS_3Na)$

They fall, therefore, properly under the second subtype, but are considered at this point on account of their analogies with garnet.

Through these species, and especially through sodalite, a connection with several other minerals is established. Sodalite occurs in elæolite syenytes, and is evidently derived from nephelite, and like the latter it yields natrolite, hydronephelite, and muscovite by alteration. Furthermore, C. and G. Friedel,‖ on heating powdered muscovite with soda solution and sodium chloride at a temperature of 500°, obtained sodalite artificially, although nephelite was probably first formed as an intermediary, and the two species were commingled in the product.

The two hexagonal species, cancrinite and microsommite, are also, like sodalite, undoubtedly derivatives of nephelite, but their formulæ are rather uncertain. Cancrinite approximates to the composition

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* Allgem. Chem. Mineralogie, p. 182.

† Allgem. Chem. Mineralogie, p. 183.

‡ Brögger and Bäckström, Zeit. Kryst. Min., XVIII, p. 209.

§ Bull. U. S. Geol. Survey No. 42, p. 38.

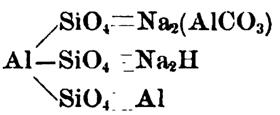
‖ Bull. Soc. Min., XIII, p. 183.

$Al_2(SiO_4)_3Na_4H(AlCO_3)$, in which a little soda is replaced by lime, and the univalent group $-Al{=}CO_3$ may be partly substituted by $-Al{=}SiO_3$. Microsommite, according to the published analyses, varies in composition widely, containing always potassium, and having a notable proportion of chlorine and sulphuric acid among its constituents. If, however, we assume in it the univalent radicles $-Al{=}Cl_2$ and $-Al{=}SO_4$, its composition reduces easily to the form $Al_2(SiO_4)_3(NaK)_3Ca(Al(SO_4.Cl_2))$, like cancrinite, both species having then the composition of the general type $Al_2(SiO_4)_3R'_6$. The theory as proposed, then, assumes univalent complex radicles for cancrinite and microsommite, and bivalent radicles for the sodalite group, thus:

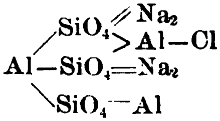
In cancrinite group.	*In sodalite group.*
$-Al{=}Cl_2$	$=Al-Cl$
$-Al{=}SO_4$	$=Al-SO_4-Na$
$-Al{=}CO_3$	$=Al-S_3-Na$
$-Al{=}SiO_3$	

and the typical structures are as follows:

Cancrinite.



Sodalite.



Concerning these formulæ and the peculiar uni- and bivalent radicles assumed in them, there are arguments both for and against. The assumption of a group $-Al{=}SiO_3$, equivalent to and replacing $-Al{=}CO_3$, is clearly suggested by the experiments of Lemberg,* who, by the action of sodium silicate solution upon elæolite, obtained a compound which he designates as a cancrinite containing Na_2SiO_3 in place of Na_2CO_3. By similar reactions with sodium carbonate he produced a substance having the composition of true cancrinite. Hence, whatever the ultimate molecular structure of cancrinite may be, we are amply justified in assuming in it the replaceability of CO_3 by SiO_3.

These experiments fairly represent a large number of like kind which are due to Lemberg, and which may be found recorded in his various papers. Some of these will be cited later, but a reference to the work of his colaborer Thugutt† is in place at this point. Starting from a hydrated nephelite, artificially prepared from kaolin, Thugutt succeeded in producing a large series of compounds analogous to sodalite, in which the original silicate had taken up, at moderately high degrees of heat and pressure, various other salts of sodium, such as the chlorate, selenate, formate, oxalate, and so on. These compounds, however, are all hydrated, and so differ from the natural minerals of the sodalite group, and they are regarded by Thugutt as formed by molecular union. Following Lemberg, he regards sodalite as a molecular compound of nephelite with sodium chloride, and taking his series of compounds throughout, he looks upon the sodium salts which have been added to the fundamental silicate as equivalent in function to water of crystallization. In favor of this view he cites many arguments, some of which are entitled to considerable weight. Thus, when sodalite is ignited NaCl is driven off, whereas if the chlorine were united with aluminum $AlCl_3$ should be expelled. Similarly, by the action of water alone, sodium chloride can be split off from the sodalite molecule, thus indicating a looser form of union than the proposed structural formulæ show.

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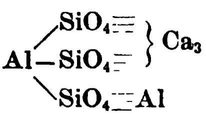
* Zeitsch. Deutsch. Geolog. Gesell., 1885, p. 962.

† Mineralchemische Studien, Dorpat, 1891.

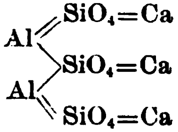
But what is molecular union? To this question there is no satisfactory answer, and even in the case of water of crystallization the term is only a confession of ignorance. Unless we assume the existence of two kinds of chemical union, it means merely that the structural linking is unknown, and that the problem is laid on one side, conveniently labeled for future reference. The constitutional formulæ here adopted for sodalite and cancrinite are intended to give a provisional solution of the problem in their particular cases, and to express the genetic relationships with nephelite on the one hand and the crystallographic analogy with garnet on the other. The objections to them raised by Thugutt are serious, but not absolutely conclusive. When sodium chloride is split off from sodalite the mechanism of the reaction is quite unknown, and the relative affinities in the molecule are quite unstudied. Until these are understood the objections raised by Lemberg, Thugutt, and others are not fatal. Furthermore, the presence of a group $=Al-Cl$ does not imply, as Thugutt supposes, the splitting off of $AlCl_3$ by heat. To effect such a decomposition three molecules of sodalite would have to be broken up, and there is no probability that such a disintegration could occur. At all events the formulæ proposed fulfill a definite purpose, even though they are not finally established. They express known relations, but not necessarily all the relations which the future may reveal. The facts that the sodalite-cancrinite minerals are derivable from nephelite, and that nephelite is again derivable from them, are unquestionable.

Taking now the formula of a typical garnet, $Al_2(SiO_4)_3Ca_3$, the question of its molecular structure remains to be considered. Regarding it as a derivative of the normal salt $Al_4(SiO_4)_3$, it may be written in at least two ways, thus:

1.



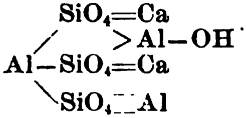
2.

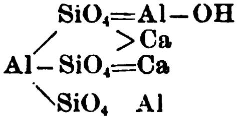


That is, isomerism is possible; and of the two species partschinite and spessartite, one may belong to one type and the other to the other.

In the first expression there is still a replaceable atom of aluminum, in the second expression none; in the first, at least, one calcium atom must link two SiO_4 groups, while in the other no such linkage occurs; and these facts may be connected with others. For example, garnet alters into mica; and the mica group, as will be seen later, contains members in which the third aluminum atom is replaced. This points at once to the first type of formula as preferable, and the alterability of garnet into epidote brings the latter mineral into the same category.

Zunyite and sodalite, being isometric, should also follow garnet; but derivatives of the second type are theoretically possible and may exist. Even under the first type alone, isomerism is conceivable, and the orthorhombic zoisite may be contrasted with the monoclinic lime epidote as follows:

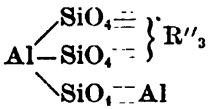




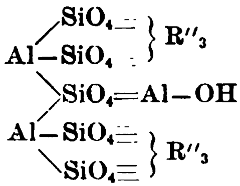
even though we can not assign either species to either formula definitely. My object here is merely to show that the formulæ have properties by virtue of which they are able to express known differences.

Additional evidence for the formula assigned to garnet is furnished by the composition of vesuvianite, which is most simply represented as formed by the coalescence of two garnet molecules, with elimination of silica. The following formulæ express this relation, and also a relation to epidote, quite perfectly:

Garnet.



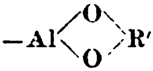
Vesuvianite.



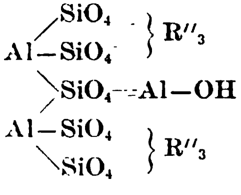
If in vesuvianite $R''_6=Ca_5Mg$, this formula gives for the composition of the typical mineral:

SiO_2	38.38
Al_2O_3	19.55
CaO	35.81
MgO	5.12
H_2O	1.14
	100.00

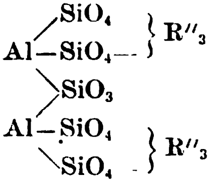
This agrees well with the published analyses, if we remember that ferric iron may partly replace aluminum, and that fluorine sometimes replaces hydroxyl. It is also sustained by the facts that garnet and vesuvianite often occur in contact limestones under similar conditions of genesis; that vesuvianite alters into garnet, and also, like garnet, into micas and chlorites; and that both species, as shown by Doelter,* yield essentially the same products upon fusion. The analogies connecting them are remarkably suggestive and complete, and the formulæ here proposed render those analogies intelligible. In the Swedish "mangan-idocrase" a salt occurs which is doubtless the vesuvianite equivalent of spessartite, but the compound in a pure state is unknown.

Two additional species, melilite and gehlenite, which, like vesuvianite, are also tetragonal, may perhaps be best considered at this stage of the discussion. For melilite, the analyses are somewhat discordant; but on the whole they agree best with Groth's formula $(\mathrm{CaMgNa_2})_6(\mathrm{AlFe})_2\mathrm{Si_5O_{19}}$. This may be written so as to resemble the formula of vesuvianite, but with the linking $\mathrm{SiO_4}$ group replaced by the bivalent $\mathrm{SiO_3}$. For gehlenite, the empirical formula $\mathrm{Ca_3Al_2Si_2O_{10}}$ is commonly assumed, but a careful comparison of the published analyses has convinced me that it is not entirely satisfactory. Most of the analyses show appreciable amounts of water, but this may be due to alteration; for the artificial gehlenite, prepared by the igneous method, is nonhydrated. A different formula, which relates gehlenite to melilite and vesuvianite, seems to be preferable; and such a formula is empirically $\mathrm{Ca_7MgAl_4Si_5O_{24}}$. In this the univalent group  $-\mathrm{Al}\langle{}^{\mathrm{O}}_{\mathrm{O}}\rangle\mathrm{R}''$ is to be assumed, which occurs also among the clintonite micas, and which, in natural gehlenite, may be replaced in part by $-\mathrm{Al}=(\mathrm{OH})_2$. On this basis the three species are comparable as follows:

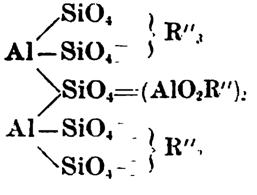
Vesuvianite.



Melilite.



Gehlenite.



These symbols are not absolutely unobjectionable, but they are useful for purposes of correlation. Gehlenite alters into garnet, melilite sometimes occurs among the products of fusion of garnet, and the formulæ suggest such relations. Furthermore, Lemberg† has shown that gehlenite, heated to 200° with a solution of potassium carbonate, gives calcium carbonate and a product having the composition of a potash mica; while similar treatment with sodium carbonate converts the mineral into cancrinite. Gehlenite, garnet, cancrinite, and muscovite are therefore related to one another, and this fact is expressed by the formulæ proposed. In melilite the calcium is partly replaced by sodium, and in some gehlenites obtained from furnace slags the same replacement has been observed.*

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*Allgem. Chem. Mineralogie, p. 183.

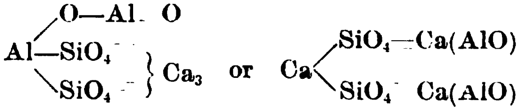
† Zeitsch. Deutsch. Geolog. Gesell., 1892, p. 237.

At the Orawitza locality, gehlenite occurs in rolled pebbles containing grains of vesuvianite. As this gehlenite contains little or no water, we may compare Janovsky's analysis of it† with the results obtained from calculation, both with the formula $Ca_3Al_2Si_2O_{10}$, and with the new formula $Al_2(SiO_4)_5R''_6(AlO_2R'')_2$, when $R''_8=Ca_7Mg$.

The results are as follows:

	Janovsky.	Old formula.	New formula.
SiO_2	32.39	30.77	32.05
Al_2O_3	18.53	26.15	21.80
Fe_2O_3	1.25		
FeO	3.61	43.08	
CaO	37.65		41.88
MgO	6.69		4.27
Ign	.51		
	100.63	100.00	100.00

Neither formula compares perfectly with the analysis, but the new is rather better than the old. With some other analyses this advantage is reversed. We need new data, based upon purer and more definite material than seems to have been as yet collected. If the old formula should be sustained, then it might be written structurally in either of two ways, thus:



The first formula would serve to connect gehlenite with garnet and the micas, while the second represents a derivative of calcium orthosilicate and fails to indicate the various relationships of the mineral to other species of this group. Neither formula, however, is so suggestive as the one which is based upon the type of vesuvianite.

Another alternative is offered by the theory of Vogt,‡ who regards melilite and gehlenite as varying mixtures of two end products; one, the "gehlenite silicate," $R'''_2R''_3Si_2O_{10}$, and the other, åkermannite, $R''_4Si_3O_{10}$. The last compound is a basic silicate, found in slags, which needs further study. Vogt's theory is plausible, and, if established, will take the two species in question, gehlenite and melilite, out of the present category as related minerals to vesuvianite and garnet.

The little-known mineral arctolite is possibly another member of this group, with affinities toward prehnite. Its composition is fairly expressed by the formula

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* See Hintze, Handbuch der Min., p. 310.

† Dana's System of Mineralogy, 6th ed., p. 476.

‡ Neues Jahrb., 1892, II, p. 73.

$$Al_2(SiO_4)_3CaMgH_2$$

which is that of prehnite with CaMg in place of Ca_2. The integrity of this species, however, is not yet fully established.

III. THE FELDSPARS AND SCAPOLITES.

Although orthosilicic and trisilicic acids are technically distinct, and from a chemical point of view should be studied separately, their salts containing aluminum occur in such a variety of mixtures that in several groups of minerals the two acids must be considered as mutually equivalent, and their compounds discussed together. Two such groups, closely allied, are the feldspars and the scapolites.

For each of these groups the theory developed by Tschermak has met with general acceptance. In the case of the feldspars, Tschermak was undoubtedly anticipated in great part by Hunt, Waltershausen, and others, but he gave to the theory its most precise statement, and to him its final establishment is due. According to this theory the triclinic plagioclase feldspars consist of albite, $AlNaSi_3O_8$, and anorthite, $Al_2Ca(SiO_4)_2$; which, commingled in various proportions, give the intermediate oligoclase, labradorite, andesite, and so on. There are also the triclinic microcline and its monoclinic equivalent, orthoclase, both represented by the formula $AlKSi_3O_8$, and the barium feldspars, such as hyalophane, which may be regarded as mixtures of orthoclase with a barium salt analogous to anorthite in composition. Microcline and orthoclase, from a chemical point of view, may be considered as isomers; and so also may albite and soda-orthoclase; but the nature of the isomerism is not clear. It may be due to the structure of the salt as such, or to the existence of two isomeric acids $H_4Si_3O_8$, and both possibilities are conceivable. For present purposes this problem may be left outstanding, and our attention can be confined to the two typical compounds, anorthite and albite. In the discussion, later, of the species eudidymite and epididymite, the question of isomeric trisilicates will come up.

For the scapolite series Tschermak has elaborated a theory which is closely parallel to that of the feldspars. These tetragonal minerals are shown to be most easily interpretable as mixtures of two end compounds, meionite, $Al_6Ca_4Si_6O_{25}$, and marialite, $Al_3Na_4Si_9O_{24}Cl$. Neither end compound has yet been found in nature quite free from the other; but the variations in composition, in optical character, etc., are all accounted for, and the theory, so far as it goes, is satisfactory. I have tentatively examined some possible alternative hypotheses, and none of them fulfills all necessary conditions so well as this scheme of Tschermak's.

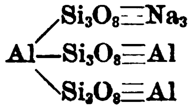
Upon studying the feldspars and scapolites more closely, certain analogies appear other than those indicated by the parallelism of the two series. Both groups of minerals are easily alterable, and both yield kaolin as a final product of the change. Furthermore, both alter into muscovite, or pinite, which is only an impure pseudomorphous mica; and kaolin, crystallographically, has close relations with the mica family. Feldspars, scapolites, muscovite, and kaolin are therefore presumably connected, and the structural formulæ of the minerals should render the relationship apparent.

The empirical formulæ to be considered are now as follows:

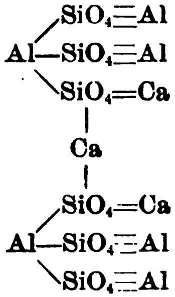
Albite	$AlNaSi_3O_8$
Anorthite	$Al_2CaSi_2O_8$
Meionite	$Al_6Ca_4Si_6O_{25}$
Marialite	$Al_3Na_4Si_9O_{24}Cl$
Muscovite	$Al_3KH_2Si_3O_{12}$
Kaolin	$Al_2H_4Si_2O_9$

For muscovite the constitution has already been indicated; and this clew, together with the general hypothesis of derivation from normal salts, enables us to correlate all six of the formulæ given. To do this it is necessary to triple the formulæ of albite and anorthite, and we have the following expressions:

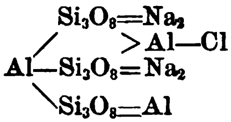
Albite.



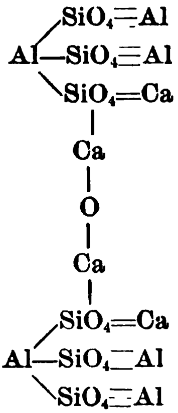
Anorthite.



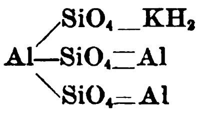
Marialite.



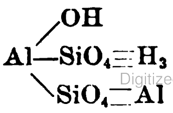
Meionite.



Muscovite.



Kaolin.

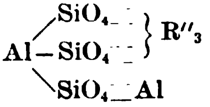


On this basis anorthite becomes the calcium equivalent of nephelite, which latter species is also alterable into kaolin. Again, garnets are known to alter into feldspars and scapolite; and, according to Brauns,* in the alteration of diabase, prehnite and epidote are sometimes derived from anorthite. These species, therefore, are all connected by numerous cross relations, all emphasizing one another and pointing to a community of molecular type. I have already called attention to the facts that anorthite and meionite occur among the products of fusion of garnet, and these data fit in well with the others. So far the formulæ are highly suggestive, but as yet they do not indicate the mechanism of the reaction by which a trisilicate feldspar breaks down into kaolin, and they need development in that direction.

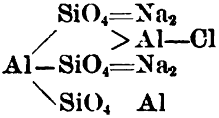
Closely allied to the feldspar in its petrographic relations is the isometric mineral leucite, $AlKSi_2O_6$. Empirically it seems to be a metasilicate, and is commonly so regarded, but it may easily be conceived as a mixed salt, containing ortho- and trisilicate molecules. By alteration it yields orthoclase, nephelite, muscovite, and kaolin, and the pseudo-leucite of Magnet Cove has been shown by J. F. Williams to consist of orthoclase and elæolite intimately commingled.† This case probably represents the typical breaking up of leucite, the formation of kaolin or of muscovite in other instances being due to secondary reactions. On the other hand, C. and G. Friedel‡ have obtained leucite synthetically from muscovite as a starting point, orthoclase and nephelite being produced at the same time; and Lemberg,§ in his experiments, has transformed leucite into sanidine, anorthite, and microsommite, and also into andesine. In a later paper|| Lemberg describes the action upon various silicates of the salt $Na_2SiO_3, 8H_2O$, at 200° under pressure, kaolin, albite, elæolite, leucite, and analcite all yielding a silicate-cancrinite containing SiO_3 in place of CO_3. These facts connect the several species together, but to their explanation the empirical expression $AlKSi_2O_6$ gives no clew. A formula for leucite, to be satisfactory, must be a multiple of this, and several such multiples fulfill the conditions of the problem.

The isometric form of leucite suggests at once a relation with garnet and the sodalite group, and this can be indicated by the quadrupled formula $Al_4K_4Si_8O_{24}$. We then have, as a distinct possibility, the following series of molecules:

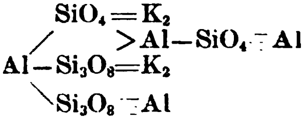
Garnet.



Sodalite.



Leucite.



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* Neues Jahrbuch, 1892, II, p. 1.

† Ann. Rept. Geol. Survey of Arkansas, 1890, II, p. 267 et seq.

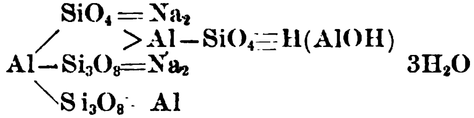
‡ Bull. Soc. Min., XIII, p. 134, 1890.

§ Zeitsch. Geol. Gesell., XXVIII, pp. 611-615, 1876.

|| Zeitsch. Geol. Gesell., pp. 961-2, 1885.

Upon this basis leucite is clearly reduced to the uniform type of the minerals to which it is related crystallographically, and also of those into which it alters; but the formula proposed can not be regarded as final. It is offered here only as a first approximation toward answering the questions which are suggested, and is therefore subject to modification in the future.

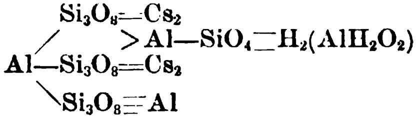
Closely allied to leucite is another isometric mineral, analcite, which, empirically, has the composition $AlNaSi_2O_6,H_2O$. This species alters, like leucite, into feldspar, and an alteration into prehnite is also recorded.* Furthermore, Lemberg has shown, in the papers already cited, that leucite, by the action of soda solutions, may be transformed into analcite, and that analcite, by similar treatment with potash, yields leucite again. With these facts in view, analcite may be written



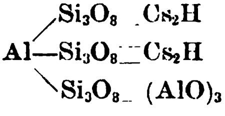
one-fourth of the water being regarded as constitutional. This last supposition, however, needs to be checked by careful experiments upon dehydration, for the data now on record are not absolutely conclusive.† A change in this detail would modify the formula given, but would not affect its general type.

Still another isometric mineral, pollucite, should possibly be considered here. Two empirical formulæ deserve to be regarded: one, based upon analyses of the Elba mineral, and given by Groth, $H_2Cs_2Al_2Si_5O_{15}$; the other, deduced by Wells‡ for the Maine pollucite, $H_2Cs_4Al_4Si_9O_{27}$. Both formulæ give metasilicate ratios, but both are reducible to the type of leucite and analcite, thus:

Elba.



Maine.



Neither formula can be regarded as conclusive, and their only value here is to show that pollucite is not necessarily a metasilicate, and that it can be represented as similar in constitution to the minerals with which it is morphologically allied. Wells's analyses are probably the better; but the formula drawn from the Elba pollucite indicates the closer analogy to leucite and analcite.

Although kaolin, mineralogically, is not a member of the feldspar group, it is properly discussable here as a derivative. The formula assigned to it in the foregoing pages is not unimpeachable, but it suggests its relations to the feldspars and micas, and also represents the fact that the water in it is wholly constitutional. In fact, the mineral is stable far above the ordinary temperatures of dehydration, so that the water can be regarded only as an essential part of the molecule.

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* Dana's System of Mineralogy, 6th ed., p. 598.

† Compare Hersch, Der Wassergehalt der Zeolithe, Zürich, 1887.

‡ Am. Jour. Sci. (3) XLI, p. 213, 1891.

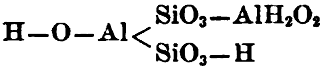
In addition to the formula proposed for kaolin, the following expressions are possible without assumption of any higher molecular weight:

(1) $Si_2O_7.H_4(AlO)_2$

(2) $Si_2O_7.H_2(AlOH)_2$. Brauns's.

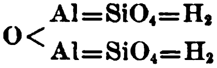
(3) $Si_2O_5.(AlH_2O_2)_2$. Groth's.

(4)



$$H-O-Al<\begin{matrix}SiO_3-AlH_2O_2\\SiO_3-H\end{matrix}$$

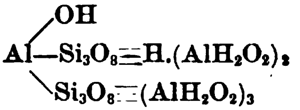
(5)



$$O<\begin{matrix}Al=SiO_4=H_2\\Al=SiO_4=H_2\end{matrix}$$

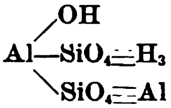
If the formula be tripled, then kaolin may be written as a basic trisilicate, thus:

(6)



$$Al\begin{matrix}/OH\\-Si_3O_8\equiv H.(AlH_2O_2)_2\\ \backslash Si_3O_8\equiv(AlH_2O_2)_3\end{matrix}$$

Of all these symbols only the last and the one originally chosen indicate the relations between kaolin and its parent species. As for these two, the formula



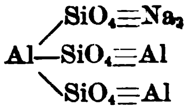
$$Al\begin{matrix}/OH\\-SiO_4\equiv H_3\\ \backslash SiO_4\equiv Al\end{matrix}$$

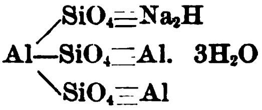
is the simpler, and would seem to represent the greater stability. Kaolin, under ordinary circumstances, is scarcely attacked by the strongest hydrochloric acid, a fact which seems to be most in harmony with the orthosilicate expression. That expression, therefore, is to be preferred; at least until more positive evidence is attainable. After dehydration at low redness, kaolin is completely decomposable by hydrochloric acid, but the ignited mass contains no silica soluble in sodium carbonate solution. These facts, developed by experiments made under my direction by Mr. George Steiger, seem to indicate the formation of a salt $Al_3Si_2O_7$ as the result of ignition, but other interpretations are possible. The data are given here simply as data, which may become available for a fuller discussion of the problem by and by. It will be seen later, when the other clays are considered, that their formulæ are in harmony with that chosen for kaolin.

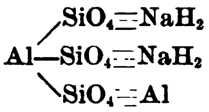
IV. THE NORMAL ZEOLITES.

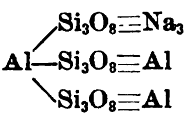
By this title is indicated a well-defined group of hydrous silicates, unmistakably related to nephelite and the feldspars, and for which the term *feldspathic zeolites* would be equally appropriate. A few zeolitic species, ptilolite, mordenite, laubanite, etc., are excluded from the present scheme, as being from a chemical point of view more properly placed elsewhere.

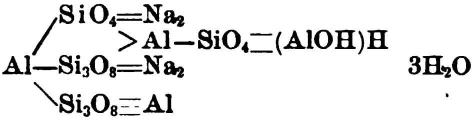
Three of the minerals in this group have already been mentioned, namely, hydronephelite, natrolite, and analcite. All of these occur as alteration products of elæolite or nephelite,* and natrolite yields nephelite again upon fusion. Natrolite and analcite are both derivable by natural processes from albite;† analcite, as shown in the preceding section, yields feldspathic pseudomorphs, and the relations of analcite to leucite are beyond controversy. From sodalite, both natrolite and hydronephelite may be generated, and from nephelite, by artificial means, Doelter has produced analcite and natrolite.‡ All of these relations, with others, both morphological and genetic, are covered by the formulæ which have already been developed, but which, in part at least, may be advantageously repeated here. Thus we have:


Nephelite.


Hydronephelite.


Natrolite.


Albite.


Analcite.

For the full significance of these expressions the previous sections must be consulted; the analcite formula being correlated with the formulæ of garnet, leucite, and the minerals of the sodalite group.

In a similar way, but rather less completely, many zeolitic minerals may be connected with anorthite, the calcium end of the plagioclase feldspar series. For example, by heating anorthite with freshly precipitated silica and carbonic acid water at 200°, Doelter obtained heulandite.§ The same investigator, after fusion of various zeolites and subsequent slow cooling, found anorthite among the substances produced by chabazite, heulandite, stilbite, scolecite, laumontite, and thomsonite.|| In some cases anorthite was the chief product of fusion; in others it was subordinate to something else. Again, by various wet reactions, some of them unfortunately involving several stages, Lemberg has generated analcite¶ from chabazite, gmelinite, laumontite, harmotome, phillipsite, stilbite, and heulandite, in some cases studying several varieties of the same species. It is clear, therefore, that the connection between the zeolites and the feldspars is unquestionable, and it

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* See Brögger, Zeit. Kryst. Min., XVI, p. 223 et seq.

† Neues Jahrb., 1892, II, p. 1; Brauns.

‡ Neues Jahrb., 1890, I, p. 134.

§ Neues Jahrb., 1890, I, p. 128, et seq.

|| Neues Jahrb., 1890, I, p. 118, and Allgem. Chem. Mineralogie, p. 183.

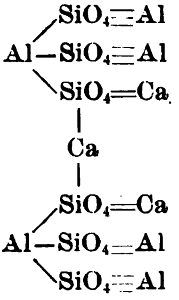
¶ Zeitsch. Geolog. Gesell., 1885, p. 959 et seq.

only remains to work out the details for each individual mineral. The fundamental relations between the two groups have been recognized by many writers; but their interpretations have been diverse.

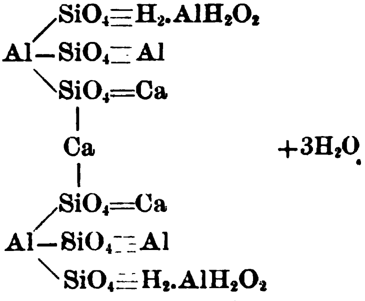
In the systematic treatment of the zeolites, the most serious difficulty is found in the hydration of the several species. To determine in any case what part of the water is constitutional and what crystalline is not easy, and no fixed criterion exists upon which judgment may be based. Water which is retained by a mineral above 300° of temperature is almost certainly constitutional; water lost at or below 100° is probably water of crystallization; but between the two there is a range of considerable vagueness. There is, however, one datum which has claims to high consideration. Certain zeolites, at various temperatures between the limits indicated, lose water which is regained without change of crystalline character upon subsequent exposure of the minerals to moist air, and this, as has been urged by several authorities, should be regarded as water of crystallization. By considerations of this kind we can be guided to some extent, but beyond them each zeolite must be studied independently, in the light of such collateral evidence as may be available. For some species the evidence is full, for others it is meager; but such as it is it will appear in the systematic discussion following.

In a recent publication* I have shown how all of the normal zeolites may be formulated as substitution derivatives of the feldspars, although in some cases alternative formulæ are readily conceivable. Thus, from anorthite several species are directly derivable, as follows:

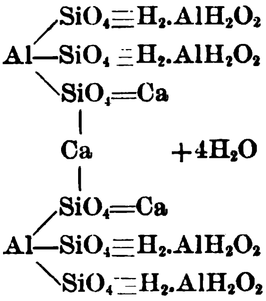
Anorthite.



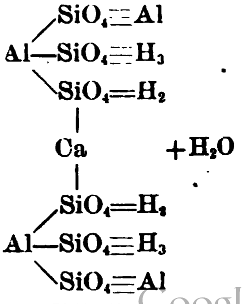
Thomsonite.



Gismondite.



Foresite.



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[*] Am. Jour. Sci. (3), XLVIII, p. 187, 1894.

Of these formulæ, the last one, that of foresite, is uncertain, on account of great variations in the published analyses. It is therefore to be regarded as approximate only, and as peculiarly subject to revision. For gismondite the composition is empirically that given by Dana, and the calcium is partly replaceable by potassium. Gismondite is said to give off one-third of its water at 100°, and in the formula that amount is represented as water of crystallization. For thomsonite the evidence is much fuller. Here four-sevenths of the water is regarded as constitutional, a proportion which is fairly in accord with the data by Damour and by Hersch, as cited in Dana.* In nature thomsonite often occurs as a derivative of elæolite, while, according to Doelter (loc. cit.), it yields anorthite upon fusion. In some cases thomsonite, variety mesole, carries an excess of silica, which may be attributed to an admixture of trisilicate groups; that is, to Si_3O_8 replacing SiO_4. In a thomsonite derived from a plagioclase feldspar this should be expected, and so also should the almost invariable replacement of a part of the calcium by sodium. Nonsodic thomsonite exists, but is probably rare. A thomsonite containing Ca_2Na_2 in place of Ca_3 would have the following theoretical composition:

SiO_2	37.27
Al_2O_3	31.68
CaO	11.59
Na_2O	6.42
H_2O	13.04
	100.00
$\frac{3}{7}H_2O$ (water of crystallization)	5.59

This agrees well with published analyses, so that the formula proposed satisfies all the conditions imposed by the evidence and also by he general substitution theory.

In scolecite, $Al_4Ca_2H_8(SiO_4)_6.2H_2O$, we find a zeolite with relations to natrolite on one side and to anorthite on the other. Approximately ne-third of its water is given off at temperatures below 300°, to be aken up again in moist air, and on fusion, according to Doelter, it yields northite. By the slow action of soda solutions it is transformed into natrolite and mesolite, while natrolite, by means of calcium hloride, is convertible into scolecite.† Mesolite, which is intermediate etween natrolite and scolecite, may be regarded as a mixture of the two, or it may be formulated as an independent compound. Written n the anorthite type, scolecite and mesolite become

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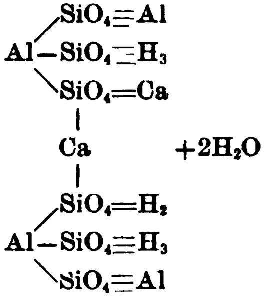
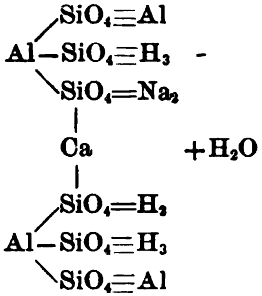
* Syst. Min., 6th ed., p. 608. Compare Hersch, Der Wassergehalt der Zeolithe, Zürich, 1887.

† Lemberg, Zeitsch. Geol. Gesell., XXVIII, p. 551, 1876.

Scolecite.

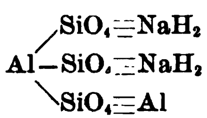


Mesolite.

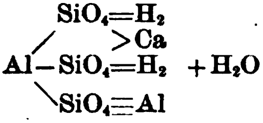


the two species being possibly miscible. On the other hand, the scolecite formula may be halved and correlated with that of natrolite, thus:

Natrolite.



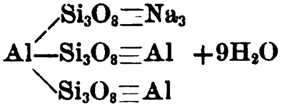
Scolecite.

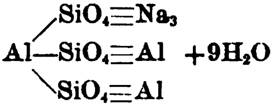


Both formulæ for scolecite satisfy the evidence, but between them it is difficult to decide. The existence of mesolite may perhaps turn the scale in favor of the anorthite structure.

By the action of barium chloride solution upon an artificial natrolite, Lemberg* obtained a barium compound which may be the equivalent of scolecite. It is also near the tetragonal edingtonite in composition. The evidence as to the constitution of edingtonite, however, is very imperfect, and dehydration data are entirely wanting. It may also be represented as the barium equivalent of the monoclinic gismondite, the difference in form being due to a difference of combination on the part of the water. At all events, it is highly probable that edingtonite is a derivative of a barium feldspar.

In the rhombohedral zeolites, gmelinite, levynite, and chabazite with its varieties, the ratios are approximately metasilicate, but somewhat variable. In this respect they resemble the feldspars, and the pseudo-metasilicate character is ascribable to mixtures of ortho- and trisilicates, with sometimes one and sometimes the other predominating. Gmelinite is essentially a sodium zeolite, with comparatively little or no lime in its composition, and when lime is present it can be attributed to a hydrous anorthite with 18 molecules of water. Apart from the lime, gmelinite is easily interpreted as a mixture of two silicates of precisely similar chemical type; one an albite, and the other its orthosilicic equivalent, thus:





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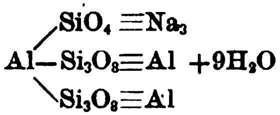
* Zeitsch. Geol. Gesell., XXVIII, p. 553, 1876.

Calculating for mixtures in the ratios of 1:1 and 2:1, we get from these formulæ the following composition of gmelinite, in comparison with analyses by Rammelsberg and by Pirsson:*

	Rammelsberg.	Pirsson.	1:1.	2:1.
SiO_2	46.48	50.67	46.89	50.89
Al_2O_3	20.64	18.50	19.92	18.21
Fe_2O_3	....	.15	....	....
CaO	3.78	1.05		
Na_2O	7.19	9.88	12.11	11.27
K_2O	1.74	.16		
H_2O	20.41	20.15	21.08	19.63
	100.24	100.56	100.00	100.00

The water is probably all crystalline, thus distinguishing gmelinite from a sodium chabazite; but the evidence on this point is incomplete. Pirsson's analysis may also be represented by a mixed salt of this character:



$$\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv Na_3}\\ \mathrm{Si_3O_8\equiv Al} \quad +9\mathrm{H_2O}\\ \mathrm{Si_3O_8\equiv Al}\end{cases}$$

indicating a relationship to analcite. Such a relation is suggested by the experiments of Lemberg,† who not only derived analcite from the zeolites of this group, but also, starting from fused analcite, obtained a compound approximating to gmelinite in composition.

For chabazite the fundamental ratios are essentially the same as with gmelinite, but the proportions between lime and soda vary greatly. Potassium is also present to a noteworthy extent in some cases, indicating a partial derivation of the mineral from leucite, orthoclase, or microcline. As regards hydration, a part of the water in chabazite appears to be constitutional, probably two molecules out of the nine shown in the gmelinite formula, but this point is not absolutely certain. The evidence in its favor is strong, but not conclusive.

The analyses of chabazite are numerous. Some of them reduce easily to mixtures of anorthite+18 aq. and albite+9 aq., and some, showing little lime, represent isomers of gmelinite. But many chabazites are very low in alkalies, while the ratio between Si_3O_8 and SiO_4 remains practically constant. In these cases it seems necessary to assume the existence of a trisilicate anorthite, or calcium albite, which, by itself, is not known in nature. According to Doelter,‡ chabazite yields upon fusion a mixture of anorthite and silica, a fact which is in harmony with the foregoing conjecture. Taking all the data into account, chabazite may be formulated as a mixture of the compound

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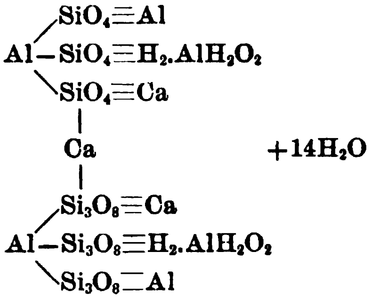
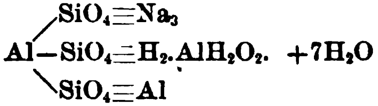
* Dana, 6th ed., p. 594.

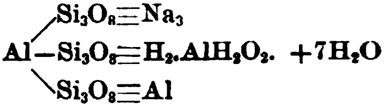
† Zeitsch. Geol. Gesell., 1885, p, 972.

‡ Allgem. Chem. Mineralogie, p. 183.



with the salts





the latter being isomeric with the gmelinite molecules. A sodium chabazite agrees in empirical composition with gmelinite, and the calcium salt by itself has the following composition, as compared with chabazite from Aussig, as analyzed by Lemberg:*

	Found.	Calculated.
SiO_2	47.50	47.43
Al_2O_3	20.00	20.15
CaO	10.20	11.07
Na_2O	.23	
K_2O	1.24	
H_2O	21.40	21.35
	100.57	100.00

It is perfectly evident that the calcium chabazite may also be written as an equimolecular mixture derived from anorthite and its trisilicate equivalent; and in levynite, the last member of the rhombohedral group, we have a mineral of the same type, although differing in hydration. Instead of 18 molecules of water, as in chabazite, levynite contains only 15; but in both cases 4 molecules are to be regarded as constitutional, in accordance with the observations made by Damour. Computing from Hillebrand's analyses,† levynite contains the ortho- and trisilicate molecules in the ratio of 3:2, giving the following empirical composition to the species:

$$3Al_6(SiO_4)_6Ca_3.\ 15H_2O + 2Al_6(Si_3O_8)_6Ca_3.\ 15H_2O,$$

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* Analysis No. 4 in Dana's table, Syst. Min., p. 591.

† Bull. U. S. Geol. Surv. No. 20, p. 38.

with the subjoined comparison between observation and theory:

	Found.	Calculated.
SiO_2	47.76	46.55
Al_2O_3	21.91	21.98
CaO	11.12	12.07
Na_2O	1.34	
K_2O	.21	
H_2O	18.65	19.40
	99.99	100.00

Here, as with the preceding minerals of this group, the accordance is quite satisfactory.

One more point with regard to chabazite remains to be noted. According to Kenngott,[*] a crystal of this mineral, heated to nearly the melting point of glass, retains its form and luster, but loses transparency. If, after cooling, such a dehydrated crystal be moistened with a drop of water, the latter is taken up with evolution of much heat. This observation may possibly imply that the constitutional hydroxyl of chabazite is united wholly or in part with calcium, in which case the formula as written by me should be correspondingly modified. CaOH would appear in it in place of AlH_2O_2, but the fundamental type need not be thereby changed. The question thus raised suggests profitable lines for experimental investigation, which ought to shed much light upon the constitution of this and other allied minerals.

The supposition that the minerals of the chabazite group may be partly derived from a trisilicate anorthite is strongly sustained by the composition of stilbite, which, most typically, is represented by the empirical formula $Ca_3Al_6(Si_3O_8)_6 + 18H_2O$. This requires

SiO_2	57.51
Al_2O_3	16.29
CaO	8.94
H_2O	17.26
	100.00

which agrees with many analyses. Some varieties of stilbite show less silica, which may be due to the presence of orthosilicate molecules, and in most cases a little soda or potash replaces lime. The latter fact represents the presence of albite, elæolite, or orthoclase among the parent minerals of the zeolite, and involves no change in the structure of the molecule. So far as can be determined from the observations of Hersch, about two-ninths of the water in stilbite is retained at moderately high temperatures, and may therefore be regarded as constitutional. On this basis the formula of the mineral becomes

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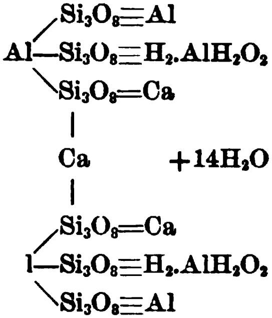
[*] Quoted by Hersch, p. 36.



which, in type, resembles that of chabazite, although the two species are crystallographically dissimilar.

To heulandite and epistilbite, two isomeric compounds, essentially the same formula belongs, but with less water of crystallization. Calculated with $Al_6(Si_3O_8)_6Ca_3.16H_2O$, we have for their composition

SiO_2	58.63
Al_2O_3	16.61
CaO	9.12
H_2O	15.64
	100.00

in close agreement with analysis. Hersch's work on heulandite shows about three-fourths of the water, or 12 molecules, to be easily expelled, leaving 4 molecules, as in stilbite, constitutional. Hence its structural formula may be written like that of stilbite, with 12 instead of 14 H_2O; or, $Al_4(Si_3O_8)_6Ca_3H_4(AlH_2O_2)_2.12H_2O$. Brewsterite appears to be like heulandite, but with barium and strontium replacing calcium.

According to Doelter, stilbite and heulandite, on fusion, yield a pyroxenic mineral with silica and an amorphous ground mass, and sometimes also anorthite. The same chemist* also effected the synthesis of heulandite from anorthite by digesting the latter with freshly precipitated silica and carbonated water at a temperature of 200°. These data are but partially interpreted by the constitutional formulæ here given, and for which alternative expressions are possible. A connection with anorthite is established, but the isomerism between heulandite and epistilbite, and the formation of a substance resembling pyroxene from stilbite and heulandite, remain to be accounted for. Possibly epistilbite may have the formula already given for this group, while stilbite and heulandite may contain the molecule

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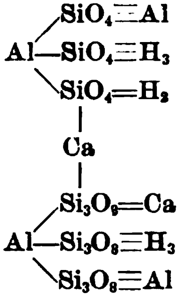
* Neues Jahrb., 1890, I, p. 128.



plus $8H_2O$ in one species and $6H_2O$ in the other. This formula was adopted in my former paper on the zeolites, and its configuration, with eight atoms of acid hydrogen, would indicate a complex breaking up upon complete dehydration. Between the two forms of expression, further investigation must decide. Both are in harmony with the fundamental theory, so that the questions at issue are mainly questions of detail.

To stilbite, morphologically, the species harmotome and phillipsite are closely allied. To harmotome may be assigned the formula $Al_6(SiO_4)_2(Si_3O_8)_4Ba_3.14H_2O$, which requires

SiO_2	45.23
Al_2O_3	16.48
BaO	24.72
H_2O	13.57
	100.00

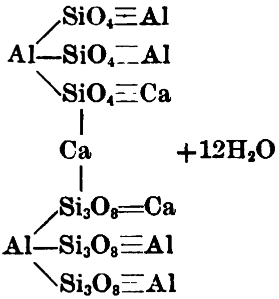
A little barium is commonly replaced by potassium or sodium, perhaps, or even probably as $Al_3(Si_3O_8)_3K_3.7H_2O$, the water being loosely combined and therefore all crystalline. In all probability harmotome is a derivative by hydration of the barium feldspar, hyalophane.

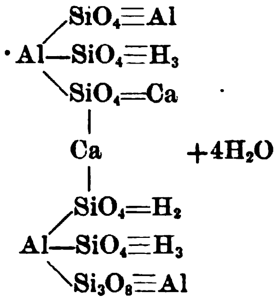
In phillipsite, which, since the investigations of Fresenius, has been generally recognized as the calcium equivalent of harmotome, we find a larger proportion of the bivalent metal replaced by potassium or sodium, and a more variable ratio between SiO_4 and Si_3O_8. A typical phillipsite approaches nearly to the formula $Al_6(SiO_4)_3(Si_3O_8)_3Ca_2K_2.14H_2O$, which requires

SiO_2	48.52
Al_2O_3	20.63
CaO	7.54
K_2O	6.33
H_2O	16.98
	100.00

Here again no water is constitutional. In my former paper I assigned to both phillipsite and harmotome a hydration of 15 molecules, but 14 agrees better with the published analyses. In some cases the calcium of phillipsite is lower and the alkaline metals higher than is shown by the ratio Ca_2K_2, but the ratio CaR'_4 does not appear to be reached, unless by the presence of H among the components of R'_4 The general formula for phillipsite and harmotome, as shown by all trustworthy analyses, is $Al_6X_6R''_3.14H_2O$, when X represents $SiO_4+Si_3O_8$ and R'' is made to include the equivalent of the alkalies. Fusion experiments upon the two species seem to be wanting.

To laumontite, $CaAl_2Si_4O_{12}.4H_2O$, two constitutional formulæ may be assigned, as follows:



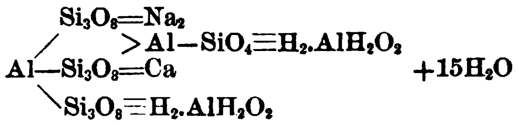


Both expressions give the same empirical composition, but the first is the more symmetrical. The second indicates a ratio between constitutional and crystalline water which agrees with the somewhat incomplete recorded data, but the first is adjustable in such a manner as to represent the same facts. According to Doelter,[*] laumontite upon fusion gives anorthite, together with a pyroxenic mineral and an amorphous ground mass, and this evidence may harmonize with either formula. A fuller experimental investigation of this species is evidently necessary.

For the isometric faujasite the formula may be written structurally in two ways. One is in uniformity with the expressions assigned to the previous species, and is

$$Al_4(SiO_4)_4(Si_3O_8)_2Na_2CaH_8.15H_2O$$

The other is based upon the analcite formula, as developed in the preceding chapter, thus:



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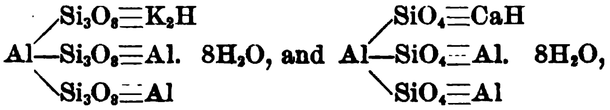
[*] Neues Jahrb., 1890, I, p. 130.

From these, which are empirically identical, we get the subjoined comparison between theory and the analysis by Damour:*

	Found.	Calculated.
SiO_2	46.12	47.46
Al_2O_3	16.81	16.14
CaO	4.79	4.43
Na_2O	5.09	4.91
H_2O	27.02	27.06
	99.83	100.00
$15H_2O=$	....	21.36

According to Jannasch,† faujasite loses 10.88 per cent of water at 105°-110°. At 150° it loses 16.83, about 12 molecules, which is regained in moist air. Between 250° and 260° it loses 22.67 per cent, and the remainder of the water is expelled upon ignition. Of the two formulæ given, the one corresponding to the leucite-analcite type is preferable, for it represents the morphological analogy between the species. Furthermore, faujasite on treatment with hydrochloric acid is decomposed, but does not gelatinize, a fact which may indicate a predominance of trisilicate over orthosilicate groups. This datum, however, is of questionable significance.

One more zeolite, the little-known species offretite, remains to be considered in this connection. This may be represented as a mixture of two molecules,



$$Al\begin{cases}Si_3O_8\equiv K_2H\\Si_3O_8\equiv Al\\Si_3O_8\equiv Al\end{cases}.\ 8H_2O,\ \text{and}\ Al\begin{cases}SiO_4\equiv CaH\\SiO_4\equiv Al\\SiO_4\equiv Al\end{cases}.\ 8H_2O,$$

in the ratio of 2:1. This gives, in comparison with Gonnard's analysis, the following composition:

	Found.‡	Calculated.
SiO_2	52.47	52.02
Al_2O_3	19.06	18.95
CaO	2.43	2.30
K_2O	7.72	7.77
H_2O	18.90	18.96
	100.58	100.00

This species is evidently a derivative of orthoclase and anorthite, and the calcium term in the foregoing formula may evidently be written on the anorthite type, namely, as $Al_6(SiO_4)_6Ca_2H_2.16H_2O$. The character of its hydration, other than is shown in the formula as given, remains to be determined. The mineral is decomposable by acids with difficulty.

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* Dana's System, 6th ed., p. 598.

† Neues Jahrb., 1887, II, p. 24.

‡ Dana's System, 6th ed., p. 1043.

From the evidence given in the foregoing pages the constitutional and genetic connection between the normal zeolites and the feldspars seems to be perfectly clear, and it ought to be easily emphasized by investigations along petrographic lines. Data of this kind, in addition to those already cited, are even now available, and many alterations of the most pertinent kind have been observed. Thus laumontite, heulandite, stilbite, and analcite alter into albite or orthoclase; laumontite and stilbite into analcite; chabazite into natrolite; and gismondite into phillipsite. So also alterations into prehnite are recorded on the part of laumontite, scolecite, mesolite, natrolite, and analcite; and the identity of chemical type seems to be almost unquestionable. From the formulæ here developed all of these alterations become intelligible, and the theory of substitution from normal salts is very emphatically sustained. For the group of zeolites it only remains to summarize the expressions which have been adopted.

For starting points the following minerals are taken:

Nephelite	$Al_3(SiO_4)_3Na_3$
Albite and orthoclase	$Al_3(Si_3O_8)_3R'_3$
Anorthite	$Al_6(SiO_4)_6Ca_3$
Trisilicic anorthite	$Al_6(Si_3O_8)_6Ca_3$

The last compound is purely hypothetical. To these may be added leucite, from which analcite and faujasite are derivable, and the barium-strontium feldspars which give rise to brewsterite, edingtonite, and harmotome. Brewsterite, as the equivalent of heulandite, and harmotome, as a barium phillipsite, need not be considered further; and as for edingtonite, its constitution is very uncertain. The remaining zeolites are as follows, with the difference between water of constitution and water of crystallization disregarded, except in the few cases in which the distinction affects the integrity of the molecular type. The symbol X is used to express SiO_4 or Si_3O_8 indiscriminately:

Type $Al_3X_3R'_3$.

Hydronephelite	$Al_3(SiO_4)_3Na_2H, 3H_2O$
Offretite	$Al_3(SiO_4)(Si_3O_8)_2R'_3, 8H_2O$
Gmelinite	$Al_3(SiO_4)(Si_3O_8)_2Na_3, 9H_2O$

Type $Al_6X_6Ca_3$.

Thomsonite	$Al_6(SiO_4)_6Ca_3, 7H_2O$
Gismondite	$Al_6(SiO_4)_6Ca_3, 12H_2O$
Laumontite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_3, 12H_2O$
Phillipsite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_2K_2, 14H_2O$
Levynite	$Al_6X_6Ca_3, 15H_2O$
Heulandite, epistilbite	$Al_6(Si_3O_8)_6Ca_3, 16H_2O$
Stilbite	$Al_6(Si_3O_8)_6Ca_3, 18H_2O$
Chabazite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_3, 18H_2O$

Type $Al_2X_3R'_6$.

Natrolite	$Al_2(SiO_4)_3Na_2H_4$
Prehnite	$Al_2(SiO_4)_3Ca_2H_2$
Scolecite	$Al_2(SiO_4)_3CaH_4, H_2O$

Type $Al_4X_6Ca_6$.

Mesolite	$Al_4(SiO_4)_6CaNa_2H_8, H_2O$
Foresite	$Al_4(SiO_4)_6CaH_{10}, H_2O$

Some of these formulæ are conditioned by the replacements and alternatives cited in the previous pages and in my former paper upon the zeolites, and they are further modified by the character of the hydration. The expressions for analcite and faujasite, as based upon the leucite type, need not be repeated.

The morphological characteristics of the zeolites probably depend in great part upon their mode of hydration, but this point needs to be developed. So also does the relation between zeolites and kaolin, into which the minerals of this group sometimes alter. Furthermore, zeolitic substances of indeterminate nature are believed to exist in soils and clays, and it is conceivable that such bodies may be intermediately formed during the transition from feldspar into kaolin. In studying the mechanism of that change this possibility ought to be considered.

V. THE MICAS AND CHLORITES.

On account of their wide distribution, their variety of composition, and their genetic relations to other species, the micas and chlorites form one of the most instructive and interesting families of minerals. Two of the micas, muscovite and biotite, have already been noted among the members of the first and second of the preceding groups; and we have seen how frequently they arise from the alteration of other silicates, while these in some cases have been synthetically derived from micaceous material.

As regards the substitution theory, the minerals of this family are peculiarly suggestive, for the reason that they form a series of the most complete character. Thus, starting from the normal aluminum orthosilicate, we have

Normal orthosilicate	$Al_4(SiO_4)_3$
Muscovite	$Al_3(SiO_4)_3KH_2$
Normal biotite	$Al_2(SiO_4)_3Mg_2KH$
Normal phlogopite	$Al(SiO_4)_3Mg_3KH_2$.

No further substitution of the same order is possible, for the reason that its formation would remove the linking atom of aluminum, and break up the fundamental molecule.

Muscovite, the first species in the foregoing series, occurs in nature as an independent mineral, and also as an alteration product of nephelite, eucryptite, topaz, andalusite, the feldspars, the scapolites, and various other natural silicates. All of these alterations become intelligible in the light of the formulæ adopted in this memoir. In its more typical occurrences muscovite agrees sharply with the formula given, but it varies in composition within well-defined limits. First, it ranges toward its sodium equivalent, paragonite, which has the corresponding formula $Al_3(SiO_4)_3NaH_2$. Secondly, in fuchsite, the chromic mica, a chromium salt partly replaces the aluminum compound, and similar ferric replacements are also known. In all of these variations, however, there is no change of ratios, and the typical formula remains undisturbed. In the barium mica, œllacherite, there is possibly a molecule of the type $Al_3(SiO_4)_3R''R'$, but this is uncertain. Other interpretations of the barium micas are admissible.

The most important variation in muscovite is in the direction of increased silica. Normal muscovite contains 45.3 per cent of SiO_2, but varieties exist in which the percentage rises to nearly 59. Muscovites of this class have been designated by Tschermak as phengites, and they are most easily explained upon the supposition of trisilicate admixtures. The molecule $Al_3(Si_3O_8)_3KH_2$ is identical in type with ordinary orthosilicate muscovite, and its presence completely accounts for all excesses of silica over the normal amount. In Sandberger's lepidomorphite, for instance, the orthosilicate and trisilicate molecules occur in nearly equal proportions. All known muscovite may be represented by the general formula $Al_3(SiO_4)_3R'_3+Al_3(Si_3O_8)_3R'_3$, in which the latter molecule varies from zero to fifty per cent, and with ferric iron or chromium sometimes replacing aluminum.

With the biotites and phlogopites the variability of composition is even greater than in the case of muscovite. For the typical molecules the composition would be

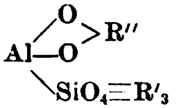
	$Al_2(SiO_4)_3Mg_2KH$.	$Al(SiO_4)_3Mg_3KH_2$.
SiO_2	43.06	43.27
Al_2O_3	24.40	12.26
MgO..........	19.14	28.85
K_2O	11.25	11.29
H_2O	2.15	4.33
	100.00	100.00

To these types but few natural micas actually correspond, although intermediate mixtures are very common. Furthermore, ferrous salts frequently replace the magnesium compounds, and ferric molecules replace those of aluminum. Manganese, also, sometimes occurs among the dyad bases, and occasionally trisilicates in small amount are commingled with the ortho-salts. Because of these complications, the reduction of a given analysis to a specific formula may be very difficult, and this difficulty is often increased by uncertainty in the determination of water, or of the state of oxidation of the iron. In spite of these difficulties, however, the reduction is generally possible, and the ferromagnesian micas, with some exceptions to be noted further on, are representable as mixtures of the two types shown in the formulæ as given. The iron mica siderophyllite agrees closely in composition with a normal ferrous biotite, $Al_2(SiO_4)_3Fe_2KH$. Aspidolite appears to be a sodium phlogopite, but needs reanalysis. In exceptional cases, muscovitic types seem to exist among these micas, and certain lepidomelanes approximate to the general formula $Al_3(SiO_4)_3Fe''K+Fe'''_3(SiO_4)_3Fe''K$. Another unusual mica is Breithaupt's alurgite, which, as analyzed by Penfield,* corresponds to a mixture of molecules

2. $Al_3(Si_3O_8)_3KH_2$
3. $Al_2(SiO_4)_3K_2H_4$
3. $Al_2(SiO_4)_3Mg_2KH$,

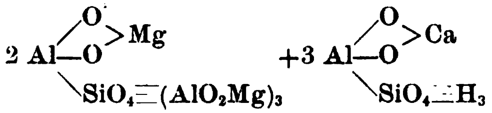
with a slight excess of H over K in the last compound. The second of these molecules, an alkaline biotite, is the characteristic feature of alurgite. Similar compounds, parallel to phlogopite, seem also to exist, having the general formula $Al(SiO_4)_3R'_9$; but all of these bodies conform sharply to the general theory of the micas, and are substitution derivatives of the normal aluminum salt.

In many of the magnesian micas fluorine is found, and the iron micas frequently contain oxygen in excess of the amount necessary to convert all of the silicon into the radicle SiO_4. When this excess is real, that is, not ascribable to defective analysis, it may be due either to alteration or to admixtures of micas belonging to the clintonite group. This group, the members of which resemble biotite morphologically, are extremely basic, and are representable by the general formula



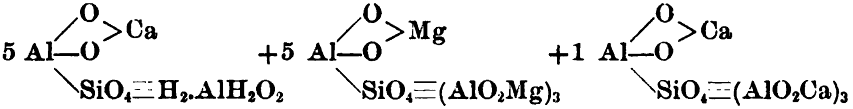
$$\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}\!>\mathrm{R''}\\ \mathrm{SiO_4}\equiv\mathrm{R'_3}\end{cases}$$

in which R'_3 may be replaced by Al, or by $R''R'$, R'' being magnesium, calcium, or ferrous iron. The univalent group AlO_2R'' may also appear in R', giving as the extreme end of the clintonite series the compound $(AlO_2R'')_4SiO_4$. In seybertite and brandisite we have nearly



$$2\,\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}\!>\mathrm{Mg}\\ \mathrm{SiO_4}\equiv(\mathrm{AlO_2Mg})_3\end{cases} +3\,\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}\!>\mathrm{Ca}\\ \mathrm{SiO_4}\equiv\mathrm{H_3}\end{cases}$$

while xanthophyllite † is



$$5\,\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}\!>\mathrm{Ca}\\ \mathrm{SiO_4}\equiv\mathrm{H_2.AlH_2O_2}\end{cases} +5\,\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}\!>\mathrm{Mg}\\ \mathrm{SiO_4}\equiv(\mathrm{AlO_2Mg})_3\end{cases} +1\,\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}\!>\mathrm{Ca}\\ \mathrm{SiO_4}\equiv(\mathrm{AlO_2Ca})_3\end{cases}$$

The xanthophyllite, upon ignition, decomposes into a portion soluble and a portion insoluble in hydrochloric acid. The insoluble portion has the composition of spinel, a mineral which is generally found accompanying clintonite micas, and of which the formation is rendered intelligible by the formulæ. Whether chloritoid belongs here or not is doubtful, but if it does its formula may be written

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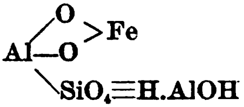
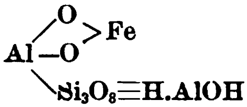
* Am. Jour. Sci., (3) XLVI, p. 289. 1893.

† See Clarke and Schneider, U. S. G. S. Bulletin No. 113, p. 27.



Ottrelite may possibly be essentially the trisilicate equivalent of chloritoid,

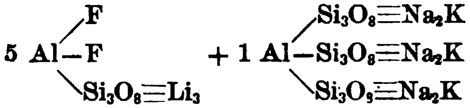


and Damour's venasquite approaches this composition. Variations in composition in ottrelite correspond to mixtures of this molecule with small quantities of chloritoid. Venasquite, however, is also reducible to the normal mica type, and agrees sharply with

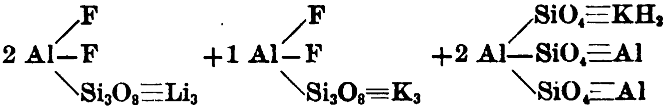
$$\begin{gathered}2\ Al_3(SiO_4)_3H_3 + \\ 3\ Al_2(SiO_4)_3Fe_2H_2\end{gathered}$$

It may be that ottrelite and its varieties represent the first stage intermediate between micas and vermiculites; the alkalies of mica having been replaced by water, all R′ becoming H.

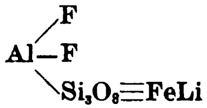
Although fluorine is found in micas of all classes, it is chiefly characteristic of lepidolite, zinnwaldite, and phlogopite, and is generally connected with a low oxygen ratio. Indeed, the extreme end of the lepidolite series, polylithionite, is entirely trisilicate in character, and its existence fully justifies the assumption that trisilicates occur in other micas. Furthermore, polylithionite furnishes a clew to the entire lepidolite or lithia mica series, and its formula is easily written



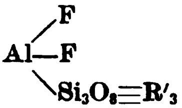
the dominant molecule being akin to clintonite in general constitution. Ordinary lepidolite contains the same molecule, mingled with molecules of the muscovite type, and an average example is represented by



In cryophyllite we have similar molecules, plus molecules of an iron biotite, $Al_2(SiO_4)_3Fe_2H_2$. Cryophyllite is associated most intimately with an iron mica of that general character, and lepidolite, similarly, is always accompanied by muscovite. In zinnwaldite the molecule

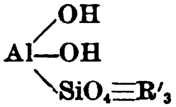


probably occurs, commingled with others of the ordinary lepidolite and muscovite types. In short, all the lithia micas contain compounds of the type



with members of the normal mica series.[*] The fluoriferous phlogopites may contain molecules of the same character, especially $AlF_2.Si_3O_8.MgK$, or they may be of the normal type with univalent $-Mg-F$ among the monad bases. Between these alternatives it is difficult to decide, and more evidence is necessary.

By alteration lepidolite passes into cookeite, a mineral which well illustrates the equivalent character of hydroxyl and fluorine. Penfield's analysis gives for cookeite a general formula,



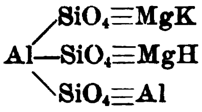
and in detail a mixture of molecules,

$$\begin{array}{l} 10Al(OH)_2SiO_4.Li_3 \\ +14Al(OH)_2SiO_4.H_3 \\ +33Al(OH)_2SiO_4.Al \end{array}$$

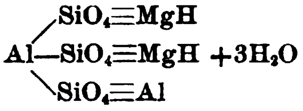
The identity of type between cookeite and lepidolite is perfectly clear, and the analogy with the clintonite micas is still more apparent.

In a similar way the other micas alter by hydration, yielding a great variety of products which are known in general as vermiculites. This is especially true as regards the ferromagnesian micas, which lose alkalies and take up water with the greatest ease, in accordance with what seems to be a well-defined law. Thus we have

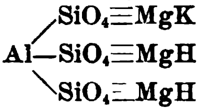
Biotite.



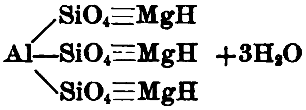
Hydrobiotite.



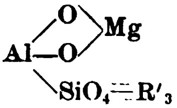
Phlogopite.



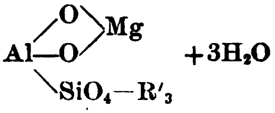
Hydrophlogopite.



Clintonite.



Hydroclintonite.



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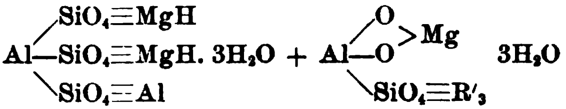
[*] For fuller discussion, see Bulletin U. S. G. S. No. 113, p. 22.

The micas in question occur in nature in great variety of admixture, and the corresponding vermiculites show a parallel complexity. In every case, however, the alteration of the one series into the other follows the line indicated by the formulæ, and the vermiculite is simply the mica with H in place of K or Na, plus 3 molecules of loosely combined water. Two of these molecules are, as a rule, given off at 100°, and regained in moist air, suggesting an analogy between the vermiculites and the zeolites. Some vermiculites, however, are only monohydrated, and many of the so-called species which have received names are mere mixtures of altered and unaltered micas, representing stages of transition between the original mineral and the final product. Among the more characteristic vermiculites, kerrite, protovermiculite, hallite, and lennilite appear to be essentially trihydrated mixtures of the hydrophlogopite and hydroclintonite types, commingled in ratios nearly as follows:

	Hydrophlog.		*Hydroclint.*
Kerrite	5	:	1
Protovermiculite	1	:	1
Hallite	7	:	18

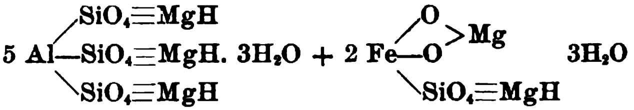
Lennilite is near hallite, and both may contain small admixtures of chloritic material. The kerrite is quite near the typical hydrophlogopite alone.

Jefferisite resembles protovermiculite in ratios, but with a hydrobiotite in place of the hydrophlogopite; that is,



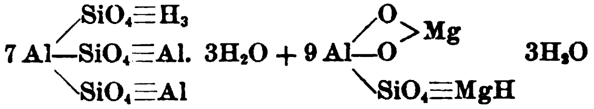
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4{\equiv}MgH}\\ -\mathrm{SiO_4{\equiv}MgH}.\ 3H_2O\\ \diagdown \mathrm{SiO_4{\equiv}Al}\end{array} + \mathrm{Al}\begin{array}{l}\diagup \mathrm{O}\\ -\mathrm{O}\\ \diagdown \mathrm{SiO_4{\equiv}R'_3}\end{array}\!\!>\mathrm{Mg}\quad 3H_2O$$

and vaalite is very nearly



$$5\ \mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4{\equiv}MgH}\\ -\mathrm{SiO_4{\equiv}MgH}.\ 3H_2O\\ \diagdown \mathrm{SiO_4{\equiv}MgH}\end{array} + 2\ \mathrm{Fe}\begin{array}{l}\diagup \mathrm{O}\\ -\mathrm{O}\\ \diagdown \mathrm{SiO_4{\equiv}MgH}\end{array}\!\!>\mathrm{Mg}\quad 3H_2O$$

Maconite and lucasite are probably micas which have been partly vermiculitized, and an essential portion of the first-named mineral appears to be a derivative of muscovite. Roseite is very near a mixture of partially muscovitic character, viz:

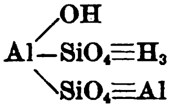


$$7\ \mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4{\equiv}H_3}\\ -\mathrm{SiO_4{\equiv}Al}.\ 3H_2O\\ \diagdown \mathrm{SiO_4{\equiv}Al}\end{array} + 9\ \mathrm{Al}\begin{array}{l}\diagup \mathrm{O}\\ -\mathrm{O}\\ \diagdown \mathrm{SiO_4{\equiv}MgH}\end{array}\!\!>\mathrm{Mg}\quad 3H_2O$$

Each of these expressions gives the composition of its respective mineral very closely, and so strengthens the general mica theory. The character of the alteration from a mica is simple, and is what is most reasonably to be expected.

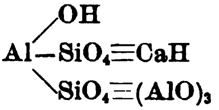
From some points of view, and especially with reference to its crystalline form, kaolin may be regarded as a member of the mica group. As such it would form a connecting link between the micas proper and the clintonite group, and with it the calcium mica, margarite, can be correlated. Furthermore, margarite yields an alteration product, dudleyite, which falls into line with the other two species, thus:

Kaolin.



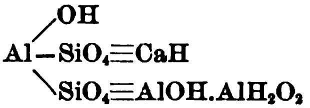
$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ \mathrm{SiO_4}\equiv\mathrm{H_3}\\ \mathrm{SiO_4}\equiv\mathrm{Al}\end{cases}$$

Margarite.



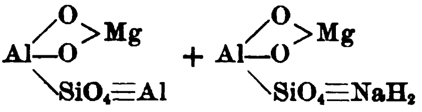
$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ \mathrm{SiO_4}\equiv\mathrm{CaH}\\ \mathrm{SiO_4}\equiv(\mathrm{AlO})_3\end{cases}$$

Dudleyite.



$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ \mathrm{SiO_4}\equiv\mathrm{CaH}\\ \mathrm{SiO_4}\equiv\mathrm{AlOH.AlH_2O_2}\end{cases}$$

These expressions are suggestive, but not altogether conclusive. They represent the known facts fairly well, however, and can serve their purpose for the time being. Several other micaceous minerals are altogether doubtful in character, and need only passing mention. Thus helvetan may be a trisilicate of the biotite type. Caswellite,[*] an alteration product of a manganesian biotite, may be written as a member of the clintonite group. Willcoxite seems to be an alkaline clintonite, and corresponds very closely to



$$\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}>\mathrm{Mg}\\ \mathrm{SiO_4}\equiv\mathrm{Al}\end{cases} + \mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}>\mathrm{Mg}\\ \mathrm{SiO_4}\equiv\mathrm{NaH_2}\end{cases}$$

There are also several vermiculitic minerals which probably belong in the chlorite group. All of these supposed species need further investigation.

In roscoelite, which is a vanadium mica, the ratios are quite uncertain. According to Genth, the mineral contains V_2O_3, while Roscoe gives the vanadium as V_2O_5; and in other respects the analyses are discordant. If Genth's analysis is accepted, roscoelite has essentially the ratios of a phengitic muscovite, with half of the aluminum replaced by vanadium. This seems to be probable, but the species needs reanalysis.

Ganophyllite, described by Hamberg in 1890,[†] and regarded by the discoverer as a manganese zeolite, should probably be classed with the micas. Like the micas, it is monoclinic, highly cleaveable, and gives a percussion figure consisting of a six-rayed star. In all its physical characteristics it resembles the micas, with one of which, manganophyll, it is associated. It loses water, however, in vacuo, regaining the amount lost on exposure to moist air, and on this account it may be compared either with the zeolites or with the vermiculite group.

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[*] Chester, Trans. N. Y. Acad. Sci., XIII, p. 97, 1894.

[†] Geol. Fören. Förhandl., XII, p. 586.

On the latter basis it agrees in composition with a hydrated manganese phlogopite, having the subjoined admixture of molecules:

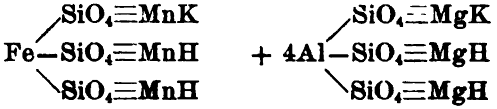
1. $Al(Si_3O_8)_3Mn_3H_3.2aq.$
1. $Al(SiO_4)_3Mn_3H_3.2aq.$
2. $Al(SiO_4)_3Mn_3KH_2.2aq.$
3. $Al(SiO_4)_3Mn_3NaH_2.2aq.$

or, in percentages, as follows:

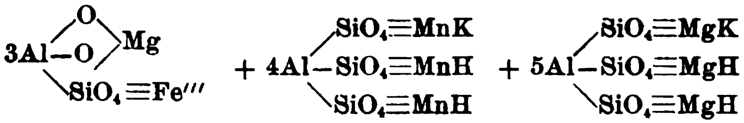
	Found.	Calculated.
SiO_2	39.67	39.99
Al_2O_3	7.95	8.81
Fe_2O_3	.90	
MnO	35.15	36.80
CaO	1.11	
MgO	.20	
PbO	.20	
K_2O	2.70	2.33
Na_2O	2.18	2.29
H_2O	9.79	9.78
	99.85	100.00

Of this water 6.22 per cent is crystalline and 3.56 constitutional.

The associated manganophyll has also phlogopite ratios, but varies so widely in composition as to show that it is, like many other micas, a mixture. Hamberg gives two analyses of this mineral; the first variety, of a reddish-brown color, agrees with



The second variety, which is dark-brown, may be written

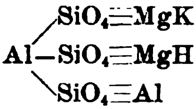


These manganophylls are from Pajsberg, but the manganophyll from Longban, analyzed by Flink, has ratios which indicate the presence of biotitic molecules somewhat similar to those found in alurgite. Manganophyll, however, contains among its constituents a true manganese phlogopite, of which ganophyllite is most probably the hydrate. On this basis both minerals are most easily explained, and all their relations are accounted for.

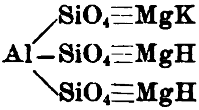
Between the micas and the chlorites the relations are exceedingly close, as regards both composition and physical properties, and from certain points of view the vermiculites are to be regarded as a transitional series connecting the two groups. All the species are highly foliated, all or nearly all are monoclinic, and to each of the definite ferromagnesian micas a chlorite, higher in magnesia and water, seems to correspond. In former publications* I have sought to show that the chlorites may be interpreted as derived from magnesium orthosilicate in the same way that the micas are derived from the normal aluminum salt; but fuller consideration leads me to a more satisfactory generalization, which unites both series under one set of fundamental formulæ.

Returning to the normal micas and ignoring the replacements of magnesium and aluminum by other equivalent bases, we have the following formulæ already developed:

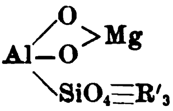
Biotite.



Phlogopite.

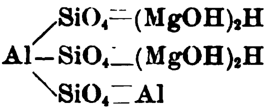


Clintonite.

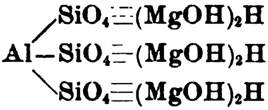


By admixtures of these types all of the ferromagnesian micas are completely explained, and for the orthochlorite series the following parallel expressions are similarly sufficient:

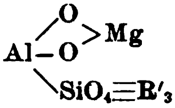
Biotite-chlorite.



Phlogopite-chlorite.



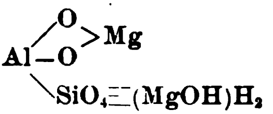
Chloritoid type.



An average pennine consists of the first and second of these types in the ratio 1:1, and an average clinochlore has the same molecules in the ratio 2:1. From these ratios the following composition is deduced:

	Pennine.	Clinochlore.
SiO_2	34.35	34.97
Al_2O_3	14.60	16.51
MgO	38.17	36.27
H_2O	12.88	12.25
	100.00	100.00

In both minerals, as among the corresponding micas, admixtures of molecules of the third type occur, giving a range of variation which is shown in the published analyses. Thus, for leuchtenbergite, we have, with the molecules given above, a large admixture of the compound



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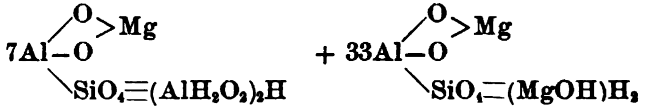
* Bull. U. S. Geol. Survey, No. 78, p. 22; Bull. No. 90, p. 17; Bull. No. 113, pp. 11 and 27.

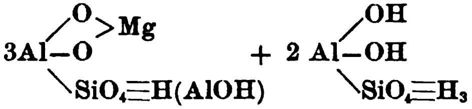
while in prochlorite and corundophilite the latter compound predominates. Prochlorite has the last formula, with trifling admixtures of chloritoid or ottrelite, and corundophilite agrees with the composition



$$7\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{Mg}\\-\mathrm{O}\\\diagdown\mathrm{SiO_4}\equiv(\mathrm{AlH_2O_2})_2\mathrm{H}\end{array}+33\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{Mg}\\-\mathrm{O}\\\diagdown\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\end{array}$$

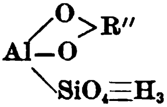
In both prochlorite and corundophilite there are large replacements of magnesium by iron.

To these formulæ some of the rarer or obscurer chlorites offer interesting variations, which, however, are all simple and intelligible. Thus, rumpfite is represented by the formula



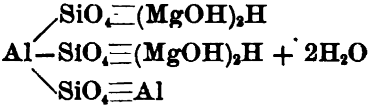
$$3\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{Mg}\\-\mathrm{O}\\\diagdown\mathrm{SiO_4}\equiv\mathrm{H}(\mathrm{AlOH})\end{array}+2\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{OH}\\-\mathrm{OH}\\\diagdown\mathrm{SiO_4}\equiv\mathrm{H_3}\end{array}$$

the first compound being a magnesian chloritoid, and the second a molecule already indicated in cookeite. The original delessite is very near



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{R''}\\-\mathrm{O}\\\diagdown\mathrm{SiO_4}\equiv\mathrm{H_3}\end{array}$$

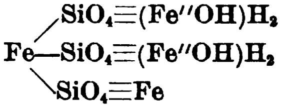
while the Scotch delessites, analyzed by Heddle, agree sharply with the formula



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}\\-\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}+2\mathrm{H_2O}\\\diagdown\mathrm{SiO_4}\equiv\mathrm{Al}\end{array}$$

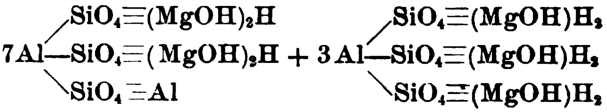
with one-fourth of the Mg replaced by Fe. In the last case the discrimination between hydroxyl and water of crystallization is shown by the analyses, and it is very probable that an analytical revision of the chlorites would bring other instances of the same kind to light.

For melanolite we have very closely the composition



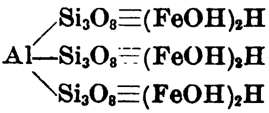
$$\mathrm{Fe}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{Fe''OH})\mathrm{H_2}\\-\mathrm{SiO_4}\equiv(\mathrm{Fe''OH})\mathrm{H_2}\\\diagdown\mathrm{SiO_4}\equiv\mathrm{Fe}\end{array}$$

and for euralite



$$7\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}\\-\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}\\\diagdown\mathrm{SiO_4}\equiv\mathrm{Al}\end{array}+3\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\\-\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\\\diagdown\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\end{array}$$

Trisilicate molecules, as among the micas, also appear in the chlorite series, and stilpnomelane is a good example of this kind. Its formula is very nearly

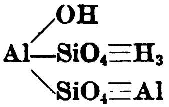


$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{Si_3O_8}\equiv(\mathrm{FeOH})_2\mathrm{H}\\-\mathrm{Si_3O_8}\equiv(\mathrm{FeOH})_2\mathrm{H}\\\diagdown\mathrm{Si_3O_8}\equiv(\mathrm{FeOH})_2\mathrm{H}\end{array}$$

with very little SiO_4, and epichlorite is a mixture of this salt with the equivalent $Al(SiO_4)_3(MgOH)_6H_3$, the two compounds being commingled in nearly equal percentages, or about half and half.

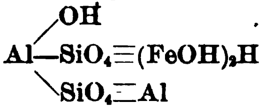
Some of the chlorites, also, are parallel with kaolin and margarite in constitution. Aphrosiderite and strigovite, for example, are well represented, as follows:

Kaolin.



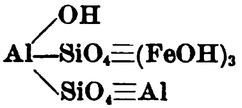
$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{OH}\\ -\mathrm{SiO_4}\equiv\mathrm{H_3}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{Al}\end{array}$$

Strigovite.



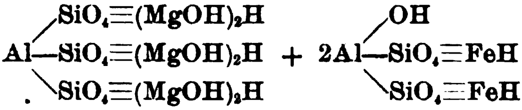
$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{OH}\\ -\mathrm{SiO_4}\equiv\mathrm{(FeOH)_2H}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{Al}\end{array}$$

Aphrosiderite.



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{OH}\\ -\mathrm{SiO_4}\equiv\mathrm{(FeOH)_3}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{Al}\end{array}$$

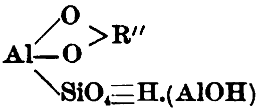
with much ferric iron in strigovite in place of aluminum. In diabantite we find a composition indicative of a mixture between a molecule of this type and one in the normal series. The diabantite from Connecticut, for instance, is very near



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv\mathrm{(MgOH)_2H}\\ -\mathrm{SiO_4}\equiv\mathrm{(MgOH)_2H}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{(MgOH)_2H}\end{array} + 2\mathrm{Al}\begin{array}{l}\diagup\mathrm{OH}\\ -\mathrm{SiO_4}\equiv\mathrm{FeH}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{FeH}\end{array}$$

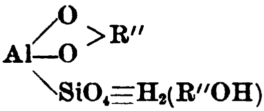
For the minerals daphnite, metachlorite, klementite, chamoisite, thuringite, and cronstedtite, the formulæ are more or less doubtful, for the reason that alternatives are possible. They all, however, reduce to mixtures of the chloritoid or clintonite type, of the forms

A.



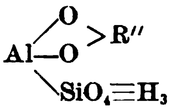
$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}\\ -\mathrm{O}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H.(AlOH)}\end{array}\! >\mathrm{R''}$$

B.



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}\\ -\mathrm{O}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H_2(R''OH)}\end{array}\! >\mathrm{R''}$$

C.



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}\\ -\mathrm{O}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H_3}\end{array}\! >\mathrm{R''}$$

Using the letters underneath the formulæ as symbols, the several species become

Chamoisite	B_1C_1, with all $R''=Fe$
Metachlorite	B_3C_1, with all $R''=Fe$
Thuringite	$A_1B_1C_1$, with all $R''=Fe$
Klementite	$A_1B_2C_1$, with R'' mostly Mg
Daphnite	$A_1B_5C_4$, with R'' mostly Fe

In cronstedtite there is a range from $A_1B_1C_1$, as in thuringite, to A_1B_2, and all the aluminum is replaced by ferric iron, while all $R''=Fe$. These expressions give the composition of the several species very closely, and serve to correlate them with delessite, rumpfite, prochlorite. and corundophilite. All of the valid evidence is satisfied, and the micas, clintonites, vermiculites, and chlorites form one systematic group. The facts that garnet and vesuvianite alter into chlorites, and that chloritic pseudomorphs after feldspar are known, serve to still more closely connect the formulæ here adopted with the similar formulæ of the preceding groups of minerals.

When clinochlore or leuchtenbergite is strongly ignited, it yields, like xanthophyllite, a product insoluble in hydrochloric acid, having the composition of spinel. This reaction establishes still more definitely the relationship between the chlorites and the clintonite group, and it is readily intelligible in the light of the structural expressions. The splitting up, under influence of heat, of mixtures containing such groups of atoms as MgOH, AlOH, and AlO_2H_2, ought to generate spinel, and the appearance of a compound of this character is evidence in favor of the formulæ.

VI. THE TOURMALINE GROUP.

Although tourmaline, in its several varieties, is apparently quite complex, the evidence for its interpretation is abundant and ample. Its variations in composition are shown by numerous good analyses, its associations are well known, and its alteration products have been observed in a sufficient number of cases. From the minerals which have been discussed in the preceding chapters, it differs essentially in that it contains boron, and the part played by this element is a new question to be interpreted.

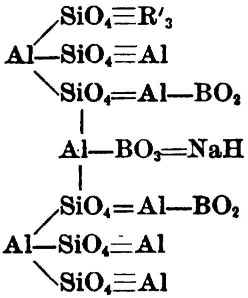
When tourmaline undergoes alteration, the commonest product is a mica, and between the micas and the tourmalines there are very striking analogies. With the lithia micas, lithia tourmalines are generally associated; with muscovite and biotite, iron tourmalines occur, and magnesian tourmalines accompany phlogopite. In each case the composition of the tourmaline seems to bear a relation to that of the associated mica. Furthermore, the varieties of tourmaline shade one into another through an unbroken series of gradations, and this may happen to some extent in one and the same crystal. The genus tourmaline, in short, represents a series of compounds, and these are parallel to the normal mica series. These considerations lead directly to a system of formulæ, which, like those of the micas, are derivable from molecules of the normal aluminum orthosilicate, and which express completely all the known chemical relations of tourmaline.

On studying carefully all the more recent and more trustworthy analyses of tourmaline, a constant ratio appears connecting silicon, boron, and oxygen, which is represented by the figures $Si_6B_3O_{31}$. The variations from constancy are almost all within the limits of accuracy of the analyses, but occasionally a small amount of fluorine is noted, which appears to replace the univalent acid group BO_2. Aluminum, with respect to silicon, varies widely, the ratio ranging from Al_8Si_6 to Al_5Si_6, while the other bases vary reciprocally with aluminum and in the opposite direction. The tourmalines high in aluminum approach, like muscovite, most nearly to the normal ortho-salt; those lowest in aluminum are high in magnesium, like phlogopite; and, like biotite in the mica group, the iron tourmalines lie between these extremes.

Taking now the smallest amount of aluminum found in the formula of any tourmaline, all varieties of the species may be regarded as containing the nucleus $Al_5(SiO_4)_6(BO_3)(BO_2)_2$, in which 14 units of affinity are still unsatisfied, and among which all of the essential variations in composition take place. The orthoboric group, BO_3, is obviously trivalent, BO_2 being univalent, and the radicle of metaboric acid.

From this nucleus four types of tourmaline are derivable, thus:

1.



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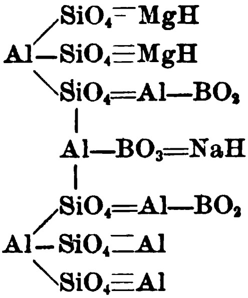
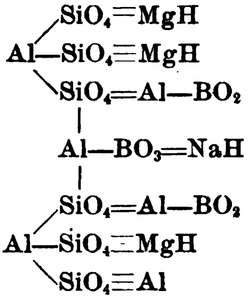
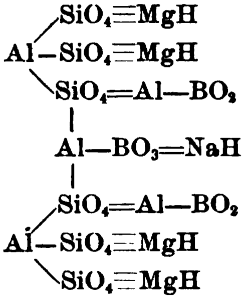


3.



4.



and to all of these, known varieties of the mineral correspond. The only notable variations are due to Cr or Fe replacing Al, Fe or Mn replacing Mg, small quantities of F replacing BO_2, and in No. 4, Ca sometimes replacing NaH. If in No. 1 $R'_3=LiH_2$, and in No. 2 Fe_2 replaces Mg_2, these formulæ give the subjoined percentage compositions:

	1	2
SiO_2	38.05	35.16
B_2O_3	11.10	10.25
Al_2O_3	43.13	34.86
FeO	....	14.06
Na_2O	3.28	3.03
Li_2O	1.58	....
H_2O	2.86	2.64
	100.00	100.00

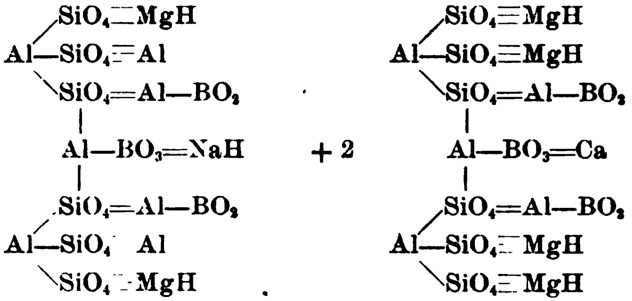
These figures agree well with the best analyses of the lithia tourmalines and the ordinary black tourmalines which are found in the same localities; divergencies being due to trifling admixtures of one with the other, and to the presence of fluorine as previously noted.

Formula No. 3 corresponds to

SiO_2	37.58
B_2O_3	10.96
Al_2O_3	31.94
MgO	12.52
Na_2O	3.24
H_2O	3.76
	100.00

which is very near the composition of the dark-brown tourmalines from Orford, N. H., and Monroe, Conn., except that in them a little Fe replaces Mg, and a little Ca takes the place of NaH.

The brown tourmalines of Hamburg, N. J., and Gouverneur, N. Y., with the white tourmaline from DeKalb, all approximate toward formula No. 4, but with admixtures of No. 3, and with Ca in place of NaH. The mixture



gives the following percentage composition:

SiO_2	37.19
B_2O_3	10.85
Al_2O_3	29.86
MgO	13.77
CaO	3.86
Na_2O	1.06
H_2O	3.41
	100.00

which represents the DeKalb tourmaline fairly well. In the Hamburg mineral there is more of the calcium compound, and in that from Gouverneur rather less. The black tourmaline from Pierrepont gives formula No. 4 very closely, except that about three-tenths of the Mg has been replaced by Fe, and one-half of the NaH by Ca. Calculating for the following mixture of molecules:

$$3Al_5(SiO_4)_6(BO_2)_2BO_3NaFe_4H_5$$
$$2Al_5(SiO_4)_6(BO_2)_2BO_3NaMg_4H_5$$
$$5Al_5(SiO_4)_6(BO_2)_2BO_3CaMg_4H_4$$

we have the following comparison with Riggs's analysis of Pierrepont tourmaline:

	Found.	Calculated.
SiO_2	35.61	35.91
TiO_2	.55	
B_2O_3	10.15	10.48
F	.27	
Al_2O_3	25.29	25.44
Fe_2O_3	.44	
FeO	8.19	8.62
MgO	11.07	11.17
CaO	3.31	2.79
Na_2O	1.51	1.55
K_2O	.20	
H_2O	3.34	4.04
	99.93	100.00

Tourmalines which do not correspond to any one of the four types given agree with mixtures of them, and all of the analyses of this mineral published by Jannasch and Calb or by Riggs can be reduced to suitable formulæ. These formulæ suggest an end product,

$$Al_9(SiO_4)_6(BO_2)_2BO_3NaH$$

which may possibly exist, but is not known. They also indicate the obvious relationship of tourmaline to the micas, and express the ready alterability of the former into the latter. A molecule of tourmaline, with elimination of boric acid and one atom of aluminum, splits into two molecules of the mica type, and the transformation is easily understood. Potash is of course taken up. Certain experiments by Lemberg,* who investigated the action of alkaline solutions upon tourmaline, are in accord with these suppositions.

Although otherwise interpreted by Brögger, the minerals cappelinite, melanocerite, karyocerite, and tritomite seem to be structurally akin to tourmaline. This view of their nature has already been suggested by Wiik,† and it is sustained both by chemical and by morphological considerations. Cappelinite is hexagonal, and the other species, like tourmaline, are rhombohedral. They are silicates of rare earths, which are mostly trivalent, like aluminum; all contain boron, and all but cappelinite contain fluorine also. Furthermore, all four species, considered together, illustrate the reciprocity between boric acid and fluorine, which has been suggested in the discussion of tourmaline.

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* Zeitsch. Deutsch. Geol. Gesell., 1892, p. 239.

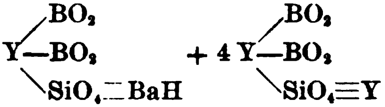
† Zeitsch. Kryst. Min., XXIII, pp. 421, 422, 1894.

Thus, if we compute the atomic ratios from the analyses cited by Brögger,* the following relation appears:

	Si.	B.	F.	B+F.
Cappelinite	236	488	....	488
Melanocerite	218	92	304	396
Karyocerite	216	134	296	430
Tritomite	226	210	226	436

That is, $Si:B+F::1:2$ nearly, variations being due to the fact that in the first three minerals the boric acid was determined by difference, and also, probably, to the occasional replacement of fluorine by hydroxyl. Another source of variation is found in the presence of tetrad bases, as will be seen later; but for the moment the relation indicated seems to be reasonably clear.

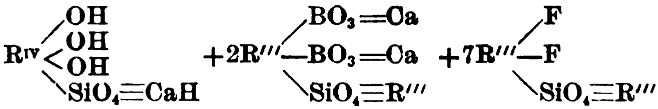
The first member of the group, cappelinite, is a borosilicate of yttrium and barium, and approximates in composition to



$$Y\begin{cases}BO_2\\BO_2\\SiO_4\equiv BaH\end{cases} + 4\,Y\begin{cases}BO_2\\BO_2\\SiO_4\equiv Y\end{cases}$$

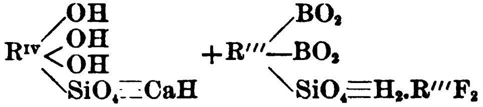
With the earths of uncertain molecular weight designated as "yttria," are a little lanthanum oxide and trifling quantities of ThO_2 and CeO_2, and with the barium are some calcium and alkalies.

The other three members of the group are all more complicated than cappelinite, and vary from it in type by containing tetrad oxides, such as CeO_2, ThO_2, and ZrO_2. In eudialyte and catapleiite we have two rhombohedral silicates of zirconia, which help to explain these compounds. Catapleiite probably has the constitution $(OH)_3Zr.Si_3O_8.R'_3$. If we regard the tetrad bases in the cappelinite group as forming orthosilicates of this same type, the remainder of each mineral may be written as a mixture of molecules like those already designated, but with cerium earths predominating over yttrium, and fluorine replacing some boric radicles. Thus, melanocerite is not far from



$$R^{IV}\begin{cases}OH\\OH\\OH\\SiO_4\equiv CaH\end{cases} + 2R'''\begin{cases}BO_3=Ca\\BO_3=Ca\\SiO_4\equiv R'''\end{cases} + 7R'''\begin{cases}F\\F\\SiO_4\equiv R'''\end{cases}$$

Karyocerite may be written similarly, and tritomite becomes



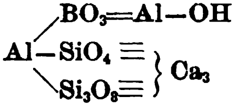
$$R^{IV}\begin{cases}OH\\OH\\OH\\SiO_4\equiv CaH\end{cases} + R'''\begin{cases}BO_2\\BO_2\\SiO_4\equiv H_2.R'''F_2\end{cases}$$

---

* Zeit. Kryst. Min., XVI, pp. 462–469.

These formulæ are uncertain, and need verification with material from other sources. At present they have only a reasonable probability. The tetrad silicate in them, however, will be seen to be highly probable when we come to the discussion of the other allied compounds in their proper connection later.

There is one other borosilicate containing aluminum, axinite, whose relations are uncertain. Physically it differs widely from tourmaline, being triclinic, but on account of its composition it may fairly be considered here. The analyses of it vary to a considerable extent, partly because of uncertainty in the determinations of water and boron, but also in other respects which indicate a mixture of molecules. Some analyses give orthosilicate ratios, provided that the boron is regarded as basic and equivalent to aluminum, but others show much too little oxygen. Boron, however, is essentially an acid-forming element, and it seems more probable that in axinite it has acid functions. The most typical axinite is that from Bourg d'Oisans, and of this the best analysis is by Jannasch and Locke.* From this the following formula is easily derived:

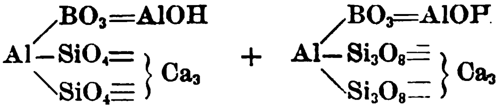


in which the boron is regarded as part of an orthoborate molecule, derived from the acid H_3BO_3.

This may be compared with Jannasch and Locke's analysis directly, and with the latter reduced by recalculating Fe_2O_3 into Al_2O_3, the other bases all into their equivalents in CaO, and then bringing to 100 per cent, thus:

	Found.	Reduced.	Calculated.
SiO_2	42.88	43.13	43.32
B_2O_3	6.02	6.06	6.32
Al_2O_3	18.24	18.73	18.41
Fe_2O_3	.62		
FeO	7.10		
MnO	1.06		
CaO	19.89	29.93	30.33
MgO	2.23		
K_2O	.11		
Na_2O	.36		
H_2O	2.14	2.15	1.62
	100.65	100.00	100.00

The formula may also be written



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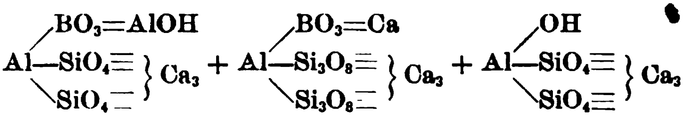
* Zeitsch. Anorgan. Chem., VI, p. 57, 1894.

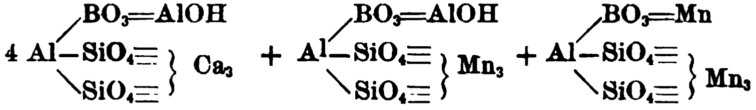
in which form it compares better with other analyses. Thus Baumert's analysis of axinite from the Radanthal[*] gives



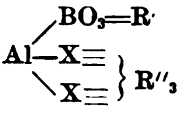
and a comparison as follows:

	Found.	Reduced.	Calculated.
SiO_2	40.76	40.92	41.32
B_2O_3	4.76	4.78	4.82
Al_2O_3	12.47	13.91	14.05
Fe_2O_3	2.17		
FeO	3.60	39.17	38.57
MnO	2.84		
CaO	30.21		
MgO	2.00		
H_2O	1.22	1.22	1.24
	100.03	100.00	100.00

Genth's analyses[*] of the axinite from Franklin, N. J., give similar ratios, minus the boron-free molecule required in Baumert's case. Approximately they give



with rather less than half the SiO_4 replaced by Si_3O_8. In general, when $X=Si_3O_8+SiO_4$ all axinite except that analyzed by Baumert gives the general formula



in which R″ is partly AlOH, with Ca, Mg, Mn, or Fe. Until further evidence is available this expression may be regarded as valid, but it represents only the composition of the mineral, and no other relations. It is, however, in conformity with the general theory of substitution. Other formulæ, which represent axinite either as metasilicate or as orthodisilicate, are possible, but none of them has any advantage over the one proposed.

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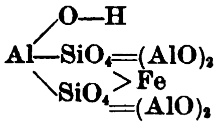
[*] Dana's System of Min., 6th ed., p. 529.

VII. MISCELLANEOUS SPECIES.

Among the ortho- and trisilicates of aluminum, ferric iron, and other triad elements, there are a considerable number which do not fall conveniently into any of the preceding groups of minerals, or which are doubtful as regards their genetic affinities. Some of them have obvious relationships to other species, and some are quite obscure in character, but all seem to be conformable to the theory of substitution.

First in order of importance is the mineral staurolite, a highly basic silicate, which is evidently akin to andalusite, dumortierite, and sillimanite, and which, like them, is orthorhombic. Like andalusite, furthermore, staurolite alters into muscovite, an entire crystal becoming transformed throughout into an aggregate of mica scales.

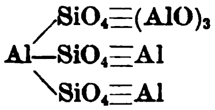
By far the best evidence as to the composition of staurolite is that furnished by the analyses of Penfield and Pratt,* who adopt Groth's formula $HAl_5Fe''Si_2O_{13}$. This, structurally, is best written



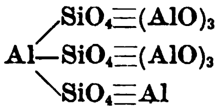
which expresses a partial relation to the micas, andalusite, and so on. The theoretical percentage composition calculated from this formula agrees well with the results of analysis, except that it gives the silica nearly one per cent too low, a discrepancy which Penfield and Pratt attribute to inclusions of silica in the minerals analyzed.

By means of a slightly different formula the relations of staurolite to the other species can be much more clearly shown, but it assumes that the ideal staurolite is not yet known. The expressions proposed are as follows:

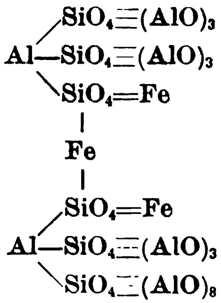
Andalusite.



Dumortierite.



Staurolite.



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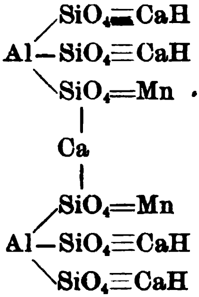
*Am. Jour. Sci., (3) XLVII, p. 81, 1894.

This formula, in contrast with that of Penfield and Pratt, and with their reduced analysis of staurolite from Lisbon, N. H., gives the subjoined percentage composition:

	Lisbon.	P. and P.	New formula.
SiO_2	27.44	26.32	27.90
Al_2O_3	55.16	55.92	55.35
FeO	15.72	15.79	16.75
H_2O	1.68	1.97	....
	100.00	100.00	100.00

If, now, we assume that the actual staurolite is slightly altered by hydration, some Fe being replaced by H_2 and by $FeOH+H$, the discrepancies between formula and analyses are sufficiently accounted for. The new formula is more symmetrical than the old one; it better expresses the alterability of staurolite into muscovite, and it seems to satisfy the evidence with sufficient completeness. When we remember that staurolite is excessively liable to inclusions and alterations, a very sharp agreement between analysis and theory is not to be expected.

Still another orthorhombic species, harstigite, has a formula analogous in some ways to that of staurolite. For harstigite there is but one analysis extant, which gives, nearly

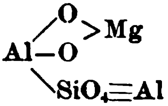


This, in comparison with Flink's analysis, gives

	Found.	Calculated.
SiO_2	38.94	39.13
Al_2O_3	10.61	11.09
MnO	12.81	15.43
MgO	3.27	
CaO	29.23	30.44
K_2O	.35	
Na_2O	.71	
H_2O	3.97	3.91
	99.89	100.00

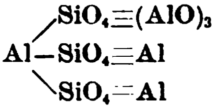
a result which is fairly satisfactory. More data relative to harstigite are evidently needed.

In order to interpret the clintonite micas, the highly basic compound

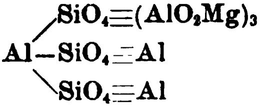


was assumed. This formula also gives, empirically, the percentage composition of the species kornerupine or prismatine, which, unlike the micas, is orthorhombic, and also insoluble in acids. On these grounds it may be compared with andalusite and staurolite; and a clew to its constitution is found in the existence of an alteration product of prismatine, kryptotile, having the composition $HAlSiO_4$. Tripling the formulæ, we have

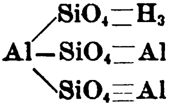
Andalusite.



Kornerupine.



Kryptotile.

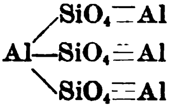


symbols which express the observed relationship between these and other species. Further than this the formulæ have no real significance, and alternative expressions are considered later in connection with the pyroxenes and amphiboles. Associated with kornerupine the still more basic sapphirine, $Mg_5Al_{12}Si_2O_{27}$, is found. To the constitution of this species there is no good clew, and any attempt at structural formulation is useless. More than one structural formula is possible for sapphirine, but all are at present meaningless, except in so far as they show that the compound is stoichiometrically conceivable.

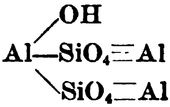
A peculiarly difficult group of minerals to interpret constitutionally is the group of clays. One member of this group, kaolin, has already been considered, and this member has the advantage of being crystalline. The other clays are amorphous, and of uncertain origin; they often occur in complicated mixtures, are difficult to identify with certainty, and still more difficult to correlate with other species. They represent undoubtedly the breaking down of crystalline silicates, to which they are related somewhat as kaolin is related to the feldspars; but rarely, if ever, has their actual genesis been observed. Their formulæ, therefore, are merely tentative, and serve only as a first step toward a better study of the several species.

Upon comparing the formula of aluminum orthosilicate with that of kaolin, an indication of serial arrangement becomes evident, which may be written thus:

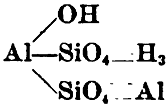
Normal salt.



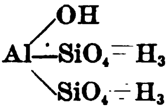
Westanite or woerthite.



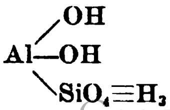
Kaolin.



Montmorillonite.



Newtonite.



Woerthite is an altered sillimanite, and westanite is perhaps a similar derivative of andalusite. The newtonite compound has already appeared in the mica series among the components of cookeite and rumpfite.

The best that can be said for these formulæ is that they are suggestive. In one respect they are highly questionable, for the reason that the group $—SiO_4\equiv H_3$ is indicative of loosely combined water, while in these particular clays the water is quite firmly retained. On this point much fuller information is needed, and future evidence may prove that the serial relation indicated is apparent only.

The composition of rectorite may be $Al_3(SiO_4)_3H_3+2H_2O$, or that of a hydrous kryptotile. Halloysite has the composition of kaolin plus one molecule of water, the latter being removable at or about 100°. Halloysite, however, differs from kaolin in being decomposable by hydrochloric acid, and hence it is unlikely that the two species have similar structure. Allophane is perhaps $(AlO_2H_2)_2H_2SiO_4+3H_2O$, or it may be written analogously to andalusite,

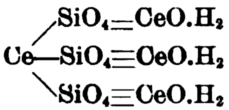
$$Al_3(SiO_4)_3(AlO_2H_2)_3.12H_2O.$$

Neither formula is sustained by any good evidence. Other clays are possibly as follows:

Samoite	$Al_4(SiO_4)_3.10H_2O$
Cimolite	$Al_4(Si_3O_8)_3.6H_2O$
Collyrite	$(AlO)_4SiO_4.6H_2O$
Schrötterite	$(AlO_2H_2)_4SiO_4.6H_2O$

None of these formulæ can be construed as anything more than a temporary suggestion, which may help research. The hydrous ferric silicates are, if anything, less satisfactory than the aluminum salts. Anthosiderite is representable by the formula $Fe_4(Si_3O_8)_3.2H_2O$; and chloropal by the expression $Fe_2(SiO_4)_3H_6$. Hisingerite seems to range from a ferric kaolin to a ferric halloysite, and farther than this it is not worth while to go. The remaining iron clays which have received specific names are altogether doubtful. The chromium clays, wolchonskoite, etc., are also of uncertain character.

To cerite, which is of doubtful composition, the provisional formula



$$Ce\begin{cases}SiO_4\equiv CeO.H_2\\ SiO_4\equiv CeO.H_2\\ SiO_4\equiv CeO.H_2\end{cases}$$

may be assigned. Other earth metals—lanthanum, the two didymiums, etc.—replace a considerable part of the cerium. With cerium only the formula requires

SiO_2	20.22
Ce_2O_3	73.71
H_2O	6.07
	100.00

Cenosite, $H_4Ca_2Y_2CSi_4O_{17}$, and ardennite, $H_5Mn_4Al_4VSi_4O_{23}$, can each be written structurally in more than one way, with no determining evidence upon which to base a decision. They may be orthosilicates or diorthosilicates; the vanadium in ardennite may be combined as VO_3 or as VO_4, or it may form part of a complex vanadio-silicic acid, and between these alternatives there is no present means of deciding. To carpholite the formula $H_4MnAl_2Si_2O_{10}$ is commonly assigned, but the analyses vary from this composition too widely. Even with this formula carpholite may be either an orthosilicate or a basic metasilicate, and we can only say with regard to this species that further investigation is necessary.

Spodumene, acmite, jadeite, and the corresponding members of the amphibole group will be considered in connection with the metasilicates. It is quite possible that these minerals are really pseudo metasilicates, and that they should properly be discussed now. Their study is deferred on mineralogical grounds solely.

Three other salts of triad bases may be noted here, as having more analogy with the salts of aluminum than with any other silicates. They are pseudobrookite, an orthotitanate of iron, $Fe_4(TiO_4)_3$, and the bismuth silicates, eulytite and agricolite, $Bi_4(SiO_4)_3$. The two last-named species differ in form but are identical in empirical composition. They, therefore, suggest two types of chemical structure among the silicates of trivalent bases.

CHAPTER IV.

THE ORTHOSILICATES OF DYAD BASES.

Although the orthosilicates of the dyad metals are presumably simpler than those of aluminum, the problem of their constitution, studied in the light of mineralogical evidence, is peculiarly difficult. Starting points exist, in the salts of magnesium, iron, manganese, zinc, and glucinum, but the derivatives are fewer than in the case of aluminum, and the evidence upon which to base argument is proportionally limited.

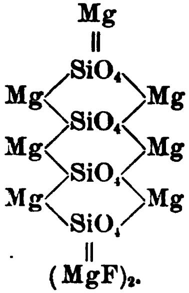
Expressed in the simplest terms, the normal orthosilicates of this group are represented by the general formula R_2SiO_4. To this type the following minerals correspond:

Forsterite	Mg_2SiO_4
Fayalite	Fe_2SiO_4
Tephroite	Mn_2SiO_4
Willemite	Zn_2SiO_4
Phenakite	Gl_2SiO_4
Monticellite	$CaMgSiO_4$
Knebelite	$MnFeSiO_4$

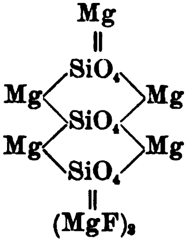
Between these minerals there are many intermediate species or varieties, which may be either isomorphous mixtures or double salts representing polymers of the fundamental type. Thus, chrysolite or olivine may be a mixture of forsterite and fayalite, or, in the case of hyalosiderite, a salt of the formula $Mg_4Fe_2(SiO_4)_3$. So also, allied to knebelite, we have igelströmite, $Fe_4Mn_2(SiO_4)_3$; and in trimerite we find the salt $Gl_3Mn_2Ca(SiO_4)_3$.

Upon studying closely the derivatives of these normal salts, the assumption of polymerization seems to be necessary. If the theory of substitution is valid, then the existence of polymers must be taken for granted; and upon this basis it becomes possible to develop a system of formulæ which satisfies all the conditions imposed by the evidence now at hand. For some of the species already mentioned the degree of polymerization is difficult to determine, and synthetic investigations seem to be needed. In other cases the problem is comparatively simple, and the indications as to the true formulæ are apparently clear. For instance, a good example is furnished by the chondrodite group, for which we have the empirical formulæ established by Penfield and Howe.* Structurally written these become

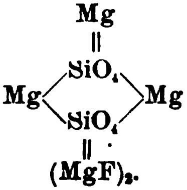
Clinohumite.



Humite.

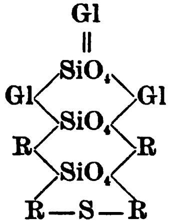


Chondrodite.



or derivatives respectively of the salts $Mg_8(SiO_4)_4$, $Mg_6(SiO_4)_3$, and $Mg_4(SiO_4)_2$, with one atom of magnesium in each case replaced by the two univalent —Mg—F groups. The clinohumite occurs in association with forsterite, and the two species have nearly the same specific gravity. Hence forsterite may be $Mg_8(SiO_4)_4$, and this is the only datum available from which to infer its molecular magnitude. The synthetic transformation of forsterite into clinohumite, if it could be effected, would go far toward settling the question.

In the case of phenakite the triple formula $Gl_6(SiO_4)_3$ is rendered probable by the existence of trimerite, $Gl_3Mn_2Ca(SiO_4)_3$. It is also emphasized by the species helvite and danalite, which contain sulphur, probably combined in the dyad group —R—S—R—. Both of these species, in all of their known occurrences, agree with the general formula



in which R may be either Fe″, Mn, or Zn. The R is variable, but the other constituents are constant. In helvite, Mn and Fe occur, and in danalite zinc appears. In the Colorado danalite Zn predominates largely over Fe, and there is very little Mn. The Rockport danalite has Fe in excess of Zn, and rather more Mn. The Cornish danalite is very low in Zn, and the Fe largely exceeds the Mn. The ratio $Gl:SiO_4::3:3$, however, holds for all.

If phenakite is $Gl_6(SiO_4)_3$, then willemite, which is morphologically similar, is probably $Zn_6(SiO_4)_3$, with zinc partly replaced by manganese in the variety known as troostite.

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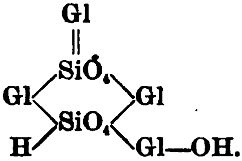
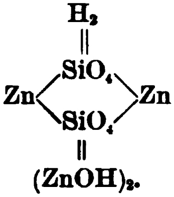
* Am. Jour. Sci. (3), XLVII, p. 188, 1894.

The three orthorhombic species, bertrandite, calamine, and ilvaite, may be most conveniently represented as derivatives of the bipolymer $R_4(SiO_4)_2$, like chondrodite. Crystallographically, ilvaite resembles humite, but bertrandite and calamine are related to each other. The simplest analogous formulæ for the three minerals are as follows:

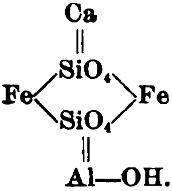
Bertrandite.



Calamine.



Ilvaite.



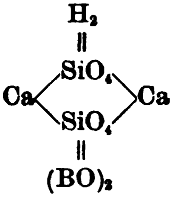
Calamine may also be written as a metasilicate, $(ZnOH)_2SiO_3$, with half of the formula indicated above, but then the analogy with bertrandite disappears. The structure proposed is, therefore, preferable, at least until more evidence has been accumulated.

To the datolite group a similar constitution is ascribable. The species, reduced to their simplest empirical expressions, are these:

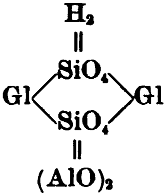
Datolite	$HCaBSiO_5$
Homilite	$Ca_2FeB_2Si_2O_{10}$
Euclase	$HGlAlSiO_5$
Gadolinite	$Gl_2FeY_2Si_2O_{10}$

By doubling the formulæ of datolite and euclase, all four of the minerals become similar in constitution. Hydrogen, here, is evidently basic, and boron must play the same part as aluminum and yttrium. Assuming these elements to be present in the univalent groups BO, AlO, and YO, the subjoined formulæ follow:

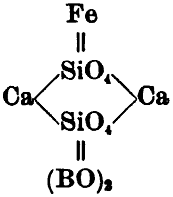
Datolite.



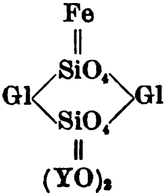
Euclase.



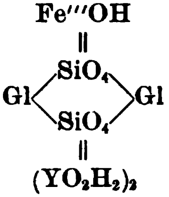
Homilite.



Gadolinite.



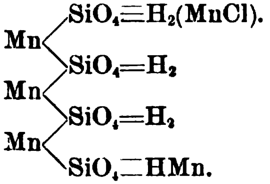
Gadolinite alters with great ease, passing by hydration into a brownish-red earthy substance. The analyses of this substance, which is probably never pure and definite, are not altogether satisfactory; but they indicate in a general way a transformation into the compound



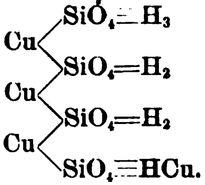
to which the alteration product very roughly approximates.

It will be observed that all of the foregoing structural formulæ in this group of compounds are rings or series of rings. From them, however, chain-like molecules are derivable, and these seem to exist in the cases of friedelite, pyrosmalite, and dioptase. The last-named mineral, simply written, is CuH_2SiO_4; but it is morphologically related to the two other species, which have a much greater complexity of composition. The following expressions derived from the polymer $R_8(SiO_4)_4$ are probably the best to represent existing evidence:

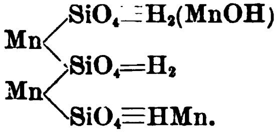
Friedelite.



Dioptase.



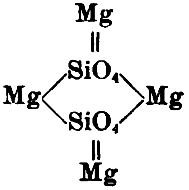
Pyrosmalite is like friedelite, but with a large part of the manganese replaced by iron. Possibly karyopilite may be similar, having the formula



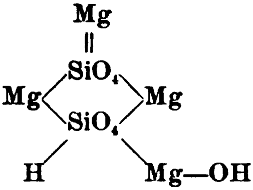
These formulæ are purely tentative and need additional support. By synthetic and genetic investigations they may be supported or overthrown. That they sustain one another, and fit in well with the formulæ of the preceding species, is all that can be said in their favor.

For serpentine, $H_4Mg_3Si_2O_9$, several formulæ are possible, and concerning them there has been much discussion. The species commonly originates in nature from the alteration of olivine on the one hand and from pyroxene or amphibole on the other, and it is therefore conceivable that it may include two or more isomeric compounds. In favor of this supposition there is no direct evidence, but still it should not be left entirely out of account.

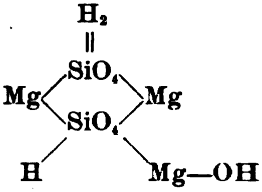
By some authorities serpentine is regarded as an orthosilicate, and by others as a salt of the acid $H_6Si_2O_7$. On the latter supposition it becomes $Mg{=}Si_2O_7{\equiv}H_2(MgOH)_2$, which may be derived either from $2\,Mg_2SiO_4$ or $2\,MgSiO_3$, with loss of magnesium in one case and gain in the other. On the orthosilicate basis it is simply derivable from the polymer $Mg_4(SiO_4)_2$, and is related to the intermediate alteration product villarsite, as follows:



$Mg_4(SiO_4)_2$.

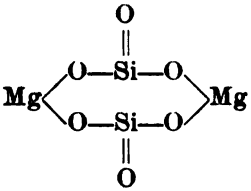


Villarsite.



Serpentine.

On this scheme the formula for serpentine corresponds with that of chondrodite; and the fact that the latter mineral alters readily into serpentine is strong evidence in its favor. If pyroxene is written structurally



the derivation of serpentine from it by action of infiltrating magnesian solutions becomes easy to understand, and the orthosilicate formula for serpentine is rendered still more probable. In short, that formula best indicates the genetic relationships of serpentine, and on these grounds is preferable to the alternative diorthosilicate expression. The latter is not disproved; it is simply rendered less advantageous as regards existing evidence, which is the evidence now to be interpreted.

In some former investigations, carried on jointly with Dr. Schneider,* I sought to obtain experimental data in support of the orthosilicate formula here assigned to serpentine. By acting on serpentine with dry gaseous hydrochloric acid we found that a part of the magnesium could be removed as chloride, while olivine and the magnesian micas were not attacked. At first it seemed probable that the reaction would give a quantitative measure of the magnesium combined as MgOH; but our later experiments and those of Lindner† have shown that the expectation was not well founded. I still believe, however, that the reaction discriminates between those magnesian silicates which contain MgOH and those which contain Mg and H combined otherwise, for only the members which must belong to the first class are acted upon by the reagent. Brauns's objections* to this supposition, on the ground that the dry hydrochloric acid becomes moist, are not well taken, for the reaction was always applied at temperatures lower than those at which water is given off. His criticisms may apply to the later stages of the reaction, after it has once fairly begun, but not to its initiation. The magnesian micas which contain several per cent of water are all decomposable by aqueous hydrochloric acid, but are scarcely touched by the dry gas, while on the other hand serpentine and the chlorites are strongly attacked. After the gaseous acid has acted it becomes moist, but very slowly, and most of the moisture is carried past the mineral under investigation before it has had time to produce an appreciable effect. It is possible, however, that a slow stream of the acid may act differently from a rapid current, and that the discordant results of observation may be due to differences of this kind.

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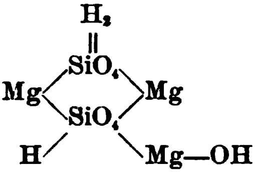
* Bull. U. S. Geol. Survey No. 78, p. 11; Bull. No. 90, p. 11, and Bull. No. 113, pp. 27 and 34.

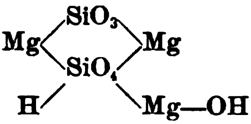
† A. Lindner, Inaugural Dissertation, Breslau, 1893.

When serpentine is ignited, water is expelled, and a residue having the composition $Mg_3Si_2O_7$ is left behind. According to Rammelsberg † the water is given off in two portions—one-half upon weak ignition, the other after heating more strongly. On the orthosilicate theory these stages may be represented thus:

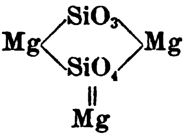
Serpentine.



First stage.

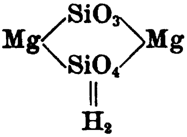


Second stage.



At the end of the second stage, if the ignition has not been too intense, the residue is still decomposable by hydrochloric acid, but by prolonged heating it is broken up quantitatively into soluble olivine and insoluble enstatite.

Allied to serpentine is the somewhat doubtful picrosmine, to which the formula $Mg_2H_2Si_2O_7$ is commonly assigned. Although this expression suggests a diorthosilicate, it may also be written



which represents picrosmine as a dehydrated serpentine altered subsequently by rehydration, with replacement of one magnesium atom by two of hydrogen. This mode of interpretation brings the mineral into line with serpentine, and all the known relations of the species are adequately expressed

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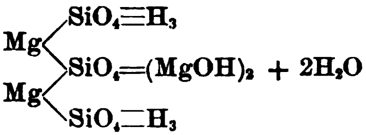
* Neues Jahrbuch, 1894. I, p. 205.

† Handbuch der Mineralchemie, 2 Aufl., p. 506.

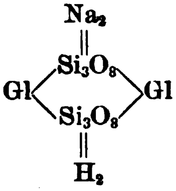
Several other hydrous silicates of magnesium seem to belong in this group, but their nature is altogether doubtful. Thus we have

Aphrodite	$Mg_3H_4(SiO_4)_3$
Kerolite	$Mg(SiO_4)_2H_5(MgOH)$

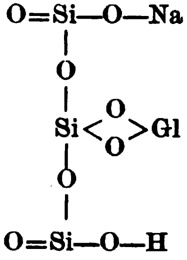
Deweylite is possibly



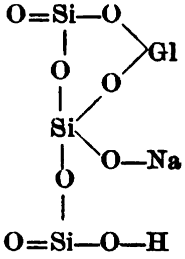
and genthite is similar, with part of the magnesium replaced by nickel. Sepiolite may be a trisilicate, with the formula $H_2{=}Si_3O_8{=}(MgOH)_2$, in which case conarite is the corresponding nickel salt. These symbols are to be regarded as suggestions only. Two other trisilicates—eudidymite and epididymite—should also be noted at this point. The two species have the same empirical formula, $HNaGlSi_3O_8$, which, doubled, becomes



a structure conformable to the type of the orthosilicates already considered. The isomerism between eudidymite and epididymite is explainable by giving one species the constitution just written, while the other, in place of Na_2 and H_2, would have the two groups NaH. It can also be ascribed to a different linking with the oxygen of the acid, and the empirical formula $HNaGlSi_3O_8$ can be put in two forms, thus:



and



a third isomer being also conceivable. The doubled formula, however, brings out analogies with bertrandite and other species and therefore, in default of evidence, is to be preferred.

CHAPTER V.

THE ORTHOSILICATES OF TETRAD BASES.

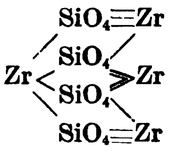
On account of their relatively small number and general scarcity, the silicates of the tetrad metals, titanium, zirconium, and thorium, are difficult to interpret in any satisfactory manner. Evidence exists, however, which seems to show that they are explainable by the same principles which apply to aluminum and the dyads, and that the theory of substitution from normal salts is a good working hypothesis to start from.

One definite normal salt is known in this series, the mineral zircon, $ZrSiO_4$. As with the other inorganic silicates, the true molecular weight of this compound is unknown, and it can be inferred only from a study of its derivatives. If we assume it to be represented by the polymeric expression $Zr_4(SiO_4)_4$, it contains replaceable basic atoms, and a number of other zirconium silicates fall naturally into series derivable from this as the fundamental member. In this connection the mineral auerbachite is peculiarly suggestive, for its composition is best indicated by the formula $Zr_4(Si_3O_8)(SiO_4)_3$; which goes to show an important analogy between this group of silicates and those which have been previously considered. This formula, compared with Hermann's analysis of auerbachite, gives the following results:

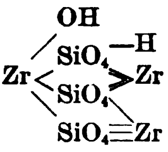
	Hermann.	Calculated.
SiO_2	42.91	42.45
ZrO_2	55.18	57.55
FeO	.93	....
H_2O	.95	....
	99.97	100.00

Although zircon is a very stable and definite mineral, it alters by hydration into malacone, cyrtolite, and a variety of other indefinite substances which can not as yet be interpreted with any clearness. At the same time other bases, such as lime and the rare earths, are taken up, producing mixtures of great complexity. Malacone is probably the first hydration derivative, and its relations to zircon, regarding the latter as $Zr_4(SiO_4)_4$, may possibly be as follows:

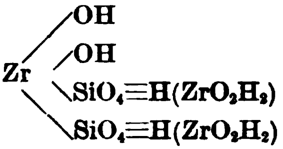
Zircon.



Malacone.



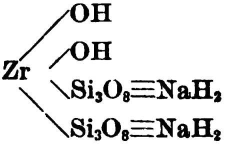
The original cyrtolite from Rockport is near malacone, but the cyrtolite from Colorado, analyzed by Hillebrand, approximates to



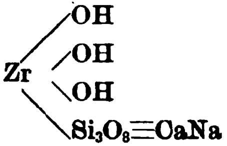
with part of the ZrO_2H_2 replaced by other bases. These formulæ, taken by themselves, are entitled to little consideration; but they become more significant when studied in connection with other compounds later. It will be noticed that one atom of zirconium is represented as linking four groups or radicles together; just as one aluminum atom has a similar triple function in the aluminous orthosilicates. This mode of linkage will be followed throughout this group of compounds.

In eudialyte, elpidite, and catapleiite we have a group of zirconium silicates which form a highly suggestive series. Taking the simpler members first, they may be represented thus:

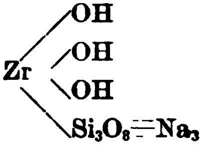
Elpidite.



Lime catapleiite.

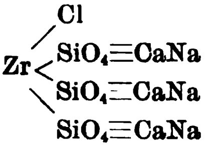


Soda catapleiite.

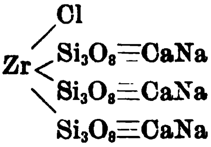


Connecting these formulæ with zircon, we have the facts that Si_3O_8 occurs in auerbachite, and that at Låven, according to Brögger,* zircon is found both intergrown with catapleiite and pseudomorphous after it.

Eudialyte and eucolite are commonly regarded as metasilicates, with the compound $ZrOCl_2$ as an admixture. But the latter is not found in nature by itself, and both minerals, unlike most of the true metasilicates, gelatinize with acids. Furthermore, the analyses of eudialyte and eucolite show a considerable range of variation in the ratio Si : O, although approximating somewhat nearly to the assumed SiO_3. If now we treat eudialyte and eucolite as mixtures of tri- and orthosilicates, like the feldspars, scapolites, and some micas, all difficulties vanish, the chlorine becomes equivalent to hydroxyl, and the minerals fall into line with catapleiite and elpidite as the first members of the series. All varieties of eudialyte and eucolite are then interpretable as mixtures of the two molecules



and



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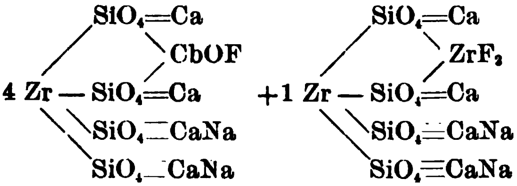
* Zeitsch. Kryst. Min., XVI, p. 105.

commingled in ratios nearly, but not exactly, 1 : 1. Hydroxyl replaces chlorine to some extent, while iron and manganese partly replace calcium; but the ratios shown by the formulæ are constant, and the structural analogies with the allied species are perfectly clear.

The remaining zirconium silicates, wöhlerite, rosenbuschite, låvenite, and hiörtdahlite, are difficult to formulate conclusively. Brögger regards them as meta compounds, and as such they are classed with the pyroxenes; but the ratio Si : O is in each case very nearly 1 : 4. In wöhlerite, which contains columbium, the latter pentavalent element may be regarded as forming the dyad group =CbOF, and as equivalent to the similar group $=ZrF_2$. On this supposition wöhlerite can be written



with small amounts of the groups R'''F replacing ZrF_2. As thus written the calculated composition agrees fairly with Cleve's analysis, thus:

	Cleve.*	Calculated.
SiO_2	30.14	30.27
TiO_2	.42	
ZrO_2	16.12	18.46
Cb_2O_5	12.85	13.52
Fe_2O_3	.48	....
Ce_2O_3	.66	....
FeO	1.26	
MnO	1.00	
MgO	.12	
CaO	26.97	28.26
Na_2O	7.50	7.83
H_2O	.74	....
F	2.98	2.87
	101.24	101.21
Less O	1.24	1.21
	100.00	100.00

* Zeit. Kryst. Min., XVI, p. 347.

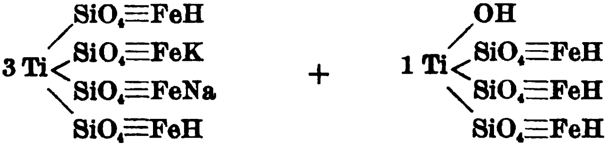
The other "zircon pyroxenes" can be interpreted in a somewhat similar manner, but the results are less satisfactory. The analyses are complicated by the presence of small amounts of titanium, which may be either acid or basic, and more data are needed before formulation can become useful.

The typical silicate of thorium, thorite, or orangite is another unsatisfactory species on account of its wide variations in composition. It is commonly supposed that the mineral, as it exists in nature, has been derived from an original $ThSiO_4$ by hydration; and that that $ThSiO_4$ was isomorphous with zircon. The nearest approach to the type is found in orangite, which may perhaps be regarded as a thorium cyrtolite, or thorium malacone. Yttrialite approximates to the composition

$$Th(Si_3O_8)_4Fe''_2(YO)_8$$

and in steenstrupine a thorium silicate exists which may be $Th(SiO_4)_4Ca_4Na_4$. Further discussion of these minerals at present would be fruitless. The data are wholly inadequate.

To the titanium silicates astrophyllite, johnstrupite, and rinkite similar formulæ to the foregoing are assignable. Indeed, this has already been done for astrophyllite by Brögger, who writes the formula $Ti(SiO_4)_4R''_4R'_4$. This seems to be the dominant molecule in astrophyllite, which, however, varies in composition. To the Colorado mineral we may more precisely give the formula



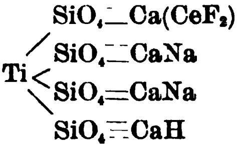
$$3\,\mathrm{Ti}\left\langle\begin{array}{l}\mathrm{SiO_4{\equiv}FeH}\\ \mathrm{SiO_4{\equiv}FeK}\\ \mathrm{SiO_4{\equiv}FeNa}\\ \mathrm{SiO_4{\equiv}FeH}\end{array}\right. + 1\,\mathrm{Ti}\left\langle\begin{array}{l}\mathrm{OH}\\ \mathrm{SiO_4{\equiv}FeH}\\ \mathrm{SiO_4{\equiv}FeH}\\ \mathrm{SiO_4{\equiv}FeH}\end{array}\right.$$

which requires

SiO_2	34.30
TiO_2	12.20
FeO	41.16
K_2O	5.36
Na_2O	3.55
H_2O	3.43
	100.00

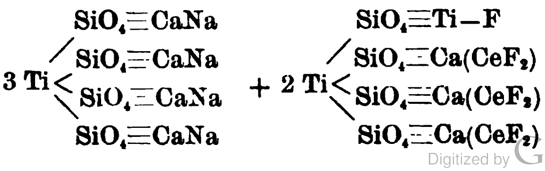
Some iron is replaced by manganese, and ferric iron, perhaps as $=Fe-OH$, is also present. In the fluoriferous astrophyllites the fluorine should replace hydroxyl.

Johnstrupite and rinkite are both fluoriferous, and both contain earths of the cerium groups. In johnstrupite, a little ZrO_2, ThO_2, and CeO_2 replace some TiO_2. For johnstrupite the expression



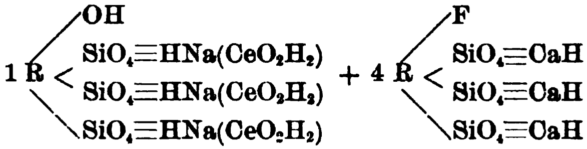
$$\mathrm{Ti}\left\langle\begin{array}{l}\mathrm{SiO_4{\equiv}Ca(CeF_2)}\\ \mathrm{SiO_4{\equiv}CaNa}\\ \mathrm{SiO_4{\equiv}CaNa}\\ \mathrm{SiO_4{\equiv}CaH}\end{array}\right.$$

agrees well with the ratios given by analysis. In rinkite we have, with great probability, the mixture



$$3\,\mathrm{Ti}\left\langle\begin{array}{l}\mathrm{SiO_4{\equiv}CaNa}\\ \mathrm{SiO_4{\equiv}CaNa}\\ \mathrm{SiO_4{\equiv}CaNa}\\ \mathrm{SiO_4{\equiv}CaNa}\end{array}\right. + 2\,\mathrm{Ti}\left\langle\begin{array}{l}\mathrm{SiO_4{\equiv}Ti{-}F}\\ \mathrm{SiO_4{\equiv}Ca(CeF_2)}\\ \mathrm{SiO_4{\equiv}Ca(CeF_2)}\\ \mathrm{SiO_4{\equiv}Ca(CeF_2)}\end{array}\right.$$

Even the complex mosandrite reduces to the same general type agreeing very closely with



$$1\,R < \begin{array}{l} OH \\ SiO_4\equiv HNa(CeO_2H_2) \\ SiO_4\equiv HNa(CeO_2H_2) \\ SiO_4\equiv HNa(CeO_2H_2) \end{array} + 4\,R < \begin{array}{l} F \\ SiO_4\equiv CaH \\ SiO_4\equiv CaH \\ SiO_4\equiv CaH \end{array}$$

in which $R=Ce^{iv} : Zr : Ti :: 1 : 2 : 2$. For each of these species the published analyses agree well with the composition calculated from these formulæ.

There is still another group of titaniferous silicates, represented by sphene, keilhauite, and tscheffkinite, which seems to be unconformable with the foregoing scheme of interpretation. Sphene, the typical member of the group, has the empirical formula $CaTiSiO_5$, for which two distinct structures have been proposed. One regards the mineral as the calcium salt of an acid, H_2TiSiO_5, analogous to $H_2Si_2O_5$, while the other treats it as a basic orthosilicate,

$$Ca=SiO_4=TiO.$$

A careful study of the recorded analyses of sphene leads me to prefer the latter expression, for the actual ratios vary in a way which indicates a replacement, sometimes of Ca and sometimes of TiO by other bases. On the meta formula, only the calcium should be replaceable. This variability of ratio is well shown by some of the varieties of sphene, such as grothite, alshedite, and eucolite-titanite, but the data are not absolutely conclusive. If, however, sphene is a basic orthosilicate, it should be placed in the preceding chapter with datolite and the other calcium salts. On the other hand, the acid character of the titanium is suggested by the remarkable hydration derivative of sphene, xanthitane, of which the composition is approximately represented by the formula $Al\equiv Ti_2O_7\equiv H_3$.

For tscheffkinite, as shown by Eakins' analyses, the composition is approximately $(FeCa)_3Ce_8Ti_4Si_6O_{32}$, but the constitution of the mineral is very doubtful. Keilhauite appears to be like sphene, with Ca or TiO replaced by $R'''OH$ or $R'''O_2H_2$, but the analyses are widely discordant. The orthorhombic guarinite is generally assumed to be isomeric with sphene, although there is but one incomplete analysis from which to calculate.

Some light may possibly be shed upon the sphene groups of mineral by a study of the columbo-titanates æschynite and polymignite. The composition of æschynite is very well represented by a mixture of molecules

$$\begin{array}{l} 2\ O=Ti=TiO_4=Ca \\ 2\ (CbO_3)_2=Ti=TiO_4=Fe \\ 3\ (CbO_3)_2=Th=TiO_4=(CeO)_2 \end{array}$$

which compares with Rammelsberg's analysis as follows:

	Found.	Calculated.
TiO_2	21.20	20.70
ThO_2	17.55	18.63
Cb_2O_5	32.51	31.52
$(Ce, La, Di)_2O_3$	19.41	23.14
$(Y, Er)_2O_3$	3.10	
FeO	3.34	3.38
Ca	2.50	2.63
	99.61	100.00

For polymignite a similar expression gives equally good results. It is

$$
\begin{array}{rl}
5 & (CbO_3)_2{=}Zr{=}TiO_4{=}(Fe'''O)_2 \\
4 & O{=}Zr{=}TiO_4{=}(CeO)_2 \\
15 & O{=}Zr{=}TiO_4{=}Ca \\
1 & O{=}Th{=}TiO_4{=}Na_2
\end{array}
$$

The similarity in type of these expressions to the orthosilicate formula for sphene is obvious. It is also obvious that the entire group is greatly in need of further study.

CHAPTER VI.

THE DIORTHOSILICATES.

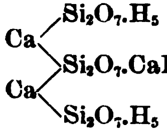
Although the existence of the sexbasic acid $H_6Si_2O_7$ has been well established by the preparation of its ethers, its metallic salts are little known and uncertain. I have already shown, in the case of serpentine, that a mineral may be apparently a diorthosilicate, and yet equally well explainable otherwise; and what is true in that instance may be true in others. For the following species the diorthosilicate formulæ seem to be the best and simplest, even though they are not wholly free from objection. They fit existing evidence, but are not absolutely conclusive.

The typical member of this group of minerals is the hexagonal lead silicate, barysilite, $Pb_3Si_2O_7$. The artificial compound from the slags of Bonneterre, Mo., described by Dana and Penfield, is near this, and may have the composition $Pb_2CaSi_2O_7$. The tetragonal ganomalite is another similar compound, approximating to $3Pb_3Si_2O_7+2Ca_3Si_2O_7$, although the latest analysis agrees rather better with $Pb_3Si_2O_7+Ca_2SiO_4$. Two other orthorhombic species, kentrolite and melanotekite, may be regarded as basic salts derived from barysilite, thus:

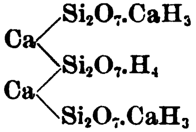
Barysilite	$Pb_2Si_2O_7Pb$
Melanotekite	$Pb_2Si_2O_7(Fe'''O)_2$
Kentrolite	$Pb_2Si_2O_7(Mn'''O)_2$

The group of zeolitic calcium silicates, okenite, gyrolite, and apophyllite, are unquestionably related to one another, and are best represented as salts of $H_6Si_2O_7$. In nature, gyrolite may be derived from apophyllite, and apophyllite also from gyrolite, while Doelter has generated apophyllite from okenite by artificial means.* First, by heating okenite with potassium silicate and water to 200°, crystals of apophyllite were obtained. Secondly, by heating okenite with aluminum chloride, sodium carbonate, and carbonated water together at 220°, apophyllite, analcite, and chabazite were produced. The most satisfactory general formulæ for the three species are these:

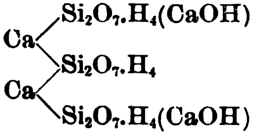
Okenite.



Gyrolite.



Apophyllite.



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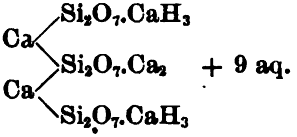
* Neues Jahrb., 1890, I, p. 118.

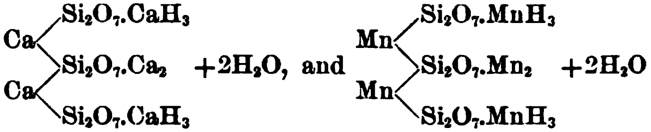
In apophyllite fluorine may partly replace hydroxyl, and K may replace the univalent CaOH. With K : CaOH : : 1 : 1 the composition of apophyllite becomes

SiO_2	52.03
CaO	24.27
K_2O	6.79
H_2O	16.91
	100.00

The uncertain mineral plombierite may be a fourth member of this group, with the formula



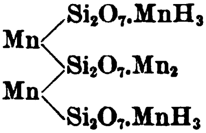
To the calcium-manganese silicate, inesite, various formulæ are assignable. By Flink it is regarded as $2(CaMn)SiO_3.H_2O$. But part of the water is stable at temperatures above 300°; and this fact is expressed by Schneider's formula $(CaMn)Si_3O_8(MnOH)_2.H_2O$. Both formulæ agree with the analyses approximately, but the latest analysis, that of Lundell,* is better represented by the following mixture:



which requires:

	Found, Lundell.	Calculated.
SiO_2	42.92	42.18
PbO	.73	
MnO	36.31	37.44
MgO	.37	
CaO	8.68	9.84
H_2O	10.48	10.54
	99.49	100.00

With inesite another manganese silicate, bementite, is perhaps related, having the formula



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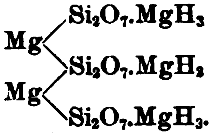
[*] See Hamberg, Geol. Fören. Förhandl., XVI, p. 325.

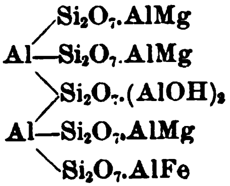
and the magnesian spadaite may be similar, with the composition



$$\begin{array}{ll} & \diagup Si_2O_7.MgH_3 \\ Mg & \\ & \diagdown\!\!\diagup Si_2O_7.MgH_2 \\ Mg & \\ & \diagdown Si_2O_7.MgH_3. \end{array}$$

Another magnesian silicate, saponite, is perhaps normally $H_4(MgOH)_2Si_2O_7$, although the analyses all show admixtures of some aluminous compound.

Among the silicates of aluminum, salts of diorthosilicic acid are very rare. The only one which seems to be at all well defined is iolite, which agrees best with the formula

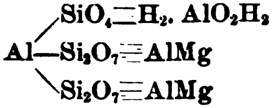


$$\begin{array}{ll} & \diagup Si_2O_7.AlMg \\ Al & \!\!-Si_2O_7.AlMg \\ & \diagdown\!\!\diagup Si_2O_7.(AlOH)_2 \\ Al & \!\!-Si_2O_7.AlMg \\ & \diagdown Si_2O_7.AlFe \end{array}$$

which requires

SiO_2	49.26
Al_2O_3	33.50
MgO	9.85
FeO	5.91
H_2O	1.48
	100.00

in close concordance with the best recorded analyses. By alteration, iolite passes into mica, going through an intermediate stage, however, known as chlorophyllite. This substance may be regarded as formed by hydration, in which the linking group of Si_2O_7 in iolite is split into two orthosilicic radicles, yielding two molecules of the type



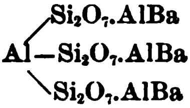
$$\begin{array}{ll} & \diagup SiO_4\equiv H_2.\ AlO_2H_2 \\ Al & \!\!-Si_2O_7\equiv AlMg \\ & \diagdown Si_2O_7\equiv AlMg \end{array}$$

from which the final transition into a mica is easy. If we take Rammelsberg's analysis of chlorophyllite, recalculate the ferric oxide into alumina and lime into magnesia, reducing afterwards to 100 per cent, we get the following comparison between observed fact and the composition of chlorophyllite computed from the foregoing formula:

	Found.	Reduced.	Calculated.
SiO_2	46.31	47.99	48.39
Al_2O_3	25.17	33.34	32.90
Fe_2O_3	10.99		
MgO	10.91	11.74	12.90
CaO	.58		
H_2O	6.70	6.93	5.81
	100.66	100.00	100.00

The agreement is as close as could be reasonably expected. The replacement of a little magnesia by a little water in the original alteration product accounts for the discrepancies.

Two other aluminous silicates possibly belong in this group. One, barylite, is near

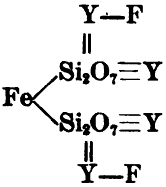


which requires

SiO_2	35.19
Al_2O_3	19.94
BaO	44.87
	100.00

The other silicate, sphenoclase, is approximately $Al_2(Si_2O_7)_3Ca_6$; which may be analogous to barylite in structure, or written as a calcium salt similar in type to okenite. Both barylite and sphenoclase, however, are uncertain, and their relations are not definitely known. The species glauconite, pholidolite, and celadonite, all of doubtful composition, seem also to have diorthosilicate ratios.

To the rare mineral rowlandite, in accordance with Hillebrand's analysis,* a diorthosilicate formula belongs, viz:



which expresses the composition of the species very closely.

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* Bull. U. S. Geol. Survey No. 113, p. 45.

CHAPTER VII.

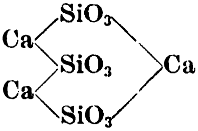
THE META- AND DIMETASILICATES.

Although the metasilicates appear at first sight to be extremely simple, they are actually quite difficult to interpret. It is easy enough to deduce their empirical formulæ, and to write them afterwards in structural terms; but this is not sufficient. The structural formulæ must express all known relations in the case of each species, and in attempting to satisfy the established conditions the difficulties begin to appear. In the first place, metasilicic acid itself is defectively known, and no ether of the form R_2SiO_3 has yet been certainly obtained. Troost and Hautfeuille's ether $(C_2H_5)_8Si_4O_{12}$ suggests the possibility that metasilicic acid, like metaphosphoric acid, may polymerize, but an attempt to draw general conclusions on so important a supposition from one datum only would be most unwise. The possibility of polymeric acids, however, must be recognized.

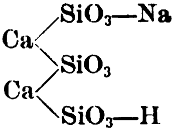
Again, as we have repeatedly seen, a mineral may be apparently a metasilicate and yet really a mixture of ortho- and trisilicates. Even a basic trisilicate can have seemingly metasilicate ratios. All of these considerations complicate the identification and study of the true metasilicates to such an extent that only provisional conclusions can be drawn from the data now on hand.

A crystallized silicate of sodium, $Na_2SiO_3.8H_2O$, is well known. A solution of this salt added to a solution of calcium chloride precipitates a compound which, dried over sulphuric acid, has, according to my own observations, the composition $Ca_2Si_2O_6.5H_2O$. This, minus the water, is analogous to the mineral wollastonite, from which another mineral, pectolite, is derived. If wollastonite, instead of the formula $Ca_2Si_2O_6$, be given the formula $Ca_3Si_3O_9$, it may be compared structurally with pectolite, as follows:

Wollastonite.



Pectolite.

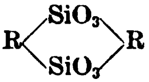


It must be remembered that the molecular weights of the inorganic silicates are not known, but only assumed; and the problem suggested by the foregoing expressions is to find a set of structural formulæ which shall represent all of the available evidence. Now, wollastonite is commonly classed with the pyroxenes, on crystallographic grounds; and so too is pectolite. But both species are very easily decomposed by even dilute and weak acids, while the normal pyroxenes are quite refractory; and furthermore, wollastonite has a lower density than any pyroxene which approaches it in composition. Chemically, then, these species are dissimilar, and it is very doubtful whether they can properly be grouped together.

Empirically, however, the nonaluminous pyroxenes resemble wollastonite in their ratios. Thus we have, according to the commonly accepted formulæ developed by Tschermak, Doelter, and others:

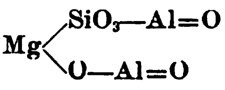
Enstatite, orthorhombic	$Mg_2Si_2O_6$
Diopside, monoclinic	$CaMgSi_2O_6$
Hedenbergite, monoclinic	$CaFeSi_2O_6$
Rhodonite, triclinic	$Mn_2Si_2O_6$

There is also a great variety of other intermediate species or isomorphous mixtures in the pyroxene series, such as bronzite, hypersthene, schefferite, sahlite, jeffersonite, and fowlerite, in which we find, variously replacing one another, salts of magnesium, calcium, iron, manganese, and zinc. All of these minerals, however, conform to the general formula $RSiO_3$, or $R_2Si_2O_6$, which adequately expresses their constitution so far as they alone are concerned. This, structurally, can be written

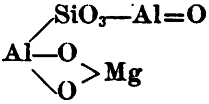


which would be satisfactory if the pyroxene series ended here and if the amphiboles were unknown.

Going a step farther we find in augite a pyroxene containing aluminum, and having an oxygen ratio greater than $Si:O_3$. In place of aluminum, ferric iron also occurs, and alkalies are sometimes present. Leaving these variations out of account, for consideration later, we have in augite, as interpreted by Tschermak, together with the normal compound $R_2Si_2O_6$, the basic salt $RAlAlSiO_6$; which, as shown by Groth, is empirically analogous to kornerupine. It is also similar in composition to the silicate which is characteristic of the clintonite micas; but the two are probably not identical. A metasilicate isomer of the clintonite molecule might be written either as



or as

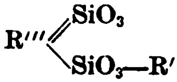


having in the first form some resemblance in structure to the metasilicate formula for the nonaluminous pyroxenes. The compound, however, unless represented by kornerupine, is not known by itself, but is assumed as existent in mixtures; its reality, therefore, is still questionable. Its simplest representation would be as a basic orthosilicate, $Mg(SiO_4)(AlO)_2$, and it will be seen later that a polymer of this form is far more satisfactory than any metasilicate expression.

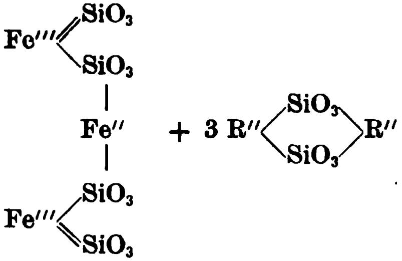
Still another series of silicates containing triad bases and also alkalies are classed with the pyroxenes, as follows:

Spodumene	$AlLiSi_2O_6$
Jadeite	$AlNaSi_2O_6$
Acmite	$Fe'''NaSi_2O_6$

and their empirical formulæ are fairly satisfactory. Structurally, these expressions become, as metasilicates,



and babingtonite, which contains no alkalies, is similar, thus:

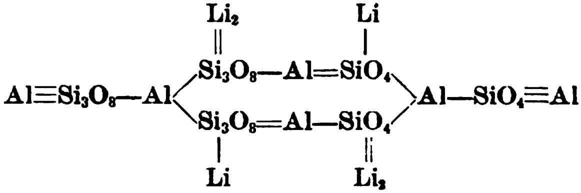


R'' being = Ca, Fe'', and Mn. The ferric molecule is evidently equivalent to two acmite molecules, with Na_2 replaced by a linking atom of iron.

So far, except partially in the comparison between wollastonite and pectolite, the formulæ cited for the pyroxenes express composition and composition only. But spodumene, as shown by the elaborate research of Brush and Dana, splits up on alteration into a mixture of eucryptite, an orthosalt, and albite, a trisilicate. This observation suggests two alternatives: either that spodumene is derived from a polymetasilicic acid, or else that it is a pseudometasilicate, a mixed ortho- and tri-salt, like some of the species which have already been explained. An analogy with leucite, for example, will at once be inferred, and that species, empirically, is strikingly like spodumene, thus:

Leucite	$AlKSi_2O_6$
Spodumene	$AlNaSi_2O_6$

Like spodumene, leucite alters into a feldspar and a member of the nepheline group; but it differs from spodumene in form and in density. The specific gravity of the isometric leucite is 2.5, that of the monoclinic spodumene is nearly 3.2, and hence we may reasonably infer that the latter species has the larger and more condensed molecule. In order to explain the relations of leucite, its empirical formula was quadrupled, and in that way a relation with the garnet group was brought out. For spodumene, regarding it also as a mixed silicate, a sixfold multiplication of its formula indicates its greater density, and its splitting up into eucryptite and albite, with partial replacement of lithium by sodium, is representable as follows:

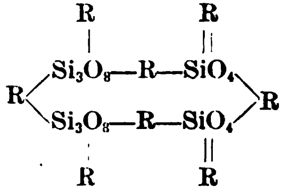


From this grouping of atoms the transition into $Al_3(Si_3O_8)_3Na_3 + Al_3(SiO_4)_3Li_3$ is hardly more than a simple case of cleavage, and the relations between the three species are intelligibly expressed. Acmite, which yields pseudomorphs of analcite, and jadeite also, probably follow the same rule, the formula of one being typical of the others. The ferric molecule in babingtonite should be still another instance of the same kind, with Fe''_3 in place of Li_6, and Fe''' instead of Al.

If the formula just developed for spodumene should be sustained, it would seem necessary to adjust the other pyroxenes with it. In the case of Tschermak's aluminous constituent of augite this adjustment is easily made by taking the formula Al_2MgSiO_6 six times, as in the case of spodumene. The parallelism between the two species is then representable as follows:

Spodumene	$Al_6(Si_3O_8)_3(SiO_4)_3Li_6$
Al. augite	$Al_6(SiO_4)_3(SiO_4)_3(AlO_2Mg)_6$

the univalent AlO_2Mg having been recognized among the micas. This formula serves to explain the well-known alterability of augite into epidote and into mica, and so far at least is useful. I do not, however, feel inclined to put very much stress upon it, for as yet it is only an expression of analogy, which may or may not prove to be valid. It would seem to require the recognition of all the pyroxenes as pseudo-metasilicates, in which case the normal series, containing only dyad bases, would become

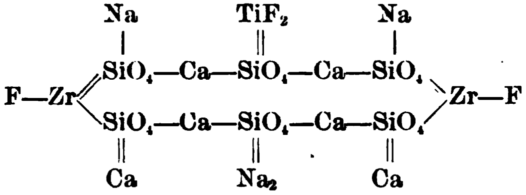


with four atoms of R given linking functions, while the other four are, so to speak, replaceably combined. On this basis we should write

Diopside	$Mg_4Ca_4(Si_3O_8)_2(SiO_4)_2$
Hedenbergite	$Fe_4Ca_4(Si_3O_8)_2(SiO_4)_2$

mula $R''_4(AlO)_8(SiO_4)_2(SiO_4)_2$ would be exactly parallel with these, ords another expression for Tschermak's compound Al_2RSiO^6. ground of simplicity this is preferable to the more complex ion based on the formula of spodumene.

o-called "zircon pyroxenes," rosenbuschite, wöhlerite, låvenite, rtdahlite, I have already mentioned among the orthosilicates of ım. They can be given metasilicate ratios, following Brögger, rding the zirconium as present in the form of a metazirconate. explanation is correct, we should expect to find zirconates in free from admixtures; but no such minerals are yet known. al zirconates have, indeed, been prepared; but zirconium is arkedly basic than acid in its functions, and the analogy furby the orthosilicate, zircon, has been my guide in the interpref these species. Rosenbuschite, however, can be represented inite compound having structural analogies with the pyroxenes, formulated, with the composition



ompares well with Cleve's analysis,[*] thus:

	Found.	Calculated.
SiO_2	31.36	30.30
ZrO_2	20.10	20.54
TiO_2	6.85	6.73
Fe_2O_3	1.00	
La_2O_3	.33	
MnO	1.39	
CaO	24.87	28.29
Na_2O	9.93	10.44
F	5.83	6.40
	101.66	102.70
Less O	2.47	2.70
	99.19	100.00

mode of interpreting the pyroxenes is so remote from our usual tions that I bring it forward with great diffidence. It unifies the however, it expresses the observed alterations of the several , and despite its complexity it will be found to be sustained and hened by evidence brought out in the study of the amphiboles. last-named group of highly important minerals resembles the nes in composition, and is explained by Tschermak in essentially ne way. Their molecular weights, however, are taken as double those of the pyroxenes, for the reason that the atomic replacements seem to occur by fourths rather than by halves. This point is exemplified by a comparison between diopside and tremolite; which, reduced to their simplest empirical formulæ, become

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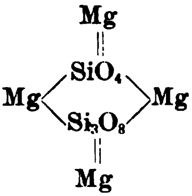
[*] Zeit. Kryst. Min., XVI, p. 383.

Diopside	$CaMgSi_2O_6$
Tremolite	$CaMg_3Si_4O_{12}$

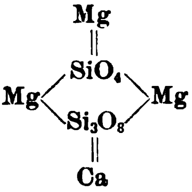
The pyroxenes, however, are somewhat heavier than the amphiboles, and from their greater density we may suppose them to have the larger molecules. Hence the formula of diopside should be a multiple of that just cited, and presumably greater than $Ca_2Mg_2Si_4O_{12}$. Upon this point the phenomenon of uralitization has definite bearing. In this process pyroxene is converted into amphibole, with increase of volume and little or no change of composition. In other words, a complex molecule has been dissociated into simpler molecules—a phenomenon the direct opposite of polymerization. In the face of this evidence it is difficult to see how the current views as to the relative molecular magnitudes of pyroxene and amphibole can be maintained. The pyroxenes must form the more complex group, and the amphiboles the simpler.

In the amphibole group the orthorhombic anthophyllite is the equivalent or isomer of enstatite and hypersthene. Then follows a monoclinic series, containing tremolite, actinolite, cummingtonite, dannemorite, etc., all being represented by the general empirical formula $RSiO_3$, with calcium, magnesium, iron, or manganese as the bivalent metal. In grünerite the salt $FeSiO_3$ exists by itself, and in richterite and astochite alkaline silicates appear. If we regard the minerals as pseudometasilicates, having molecular weights lower than the pyroxenes, and, with the bases replaceable by fourths, the typical amphiboles are most simply represented by formulæ like the following:

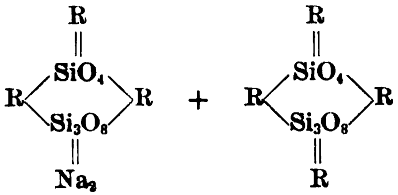
Anthophyllite.



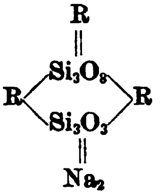
Tremolite.



Richterite becomes a mixture of salts,

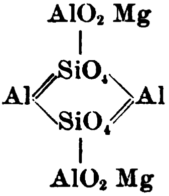


commingled in ratios near 1:1, and astochite is similar, but with NaH in place of Na_2. Potassium may also partly replace sodium. Another alkaline amphibole of doubtful character, waldheimite, approximates to

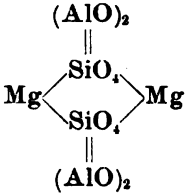


which is the formula of a trisilicate pure and simple, with R=Ca, Fe, Mg. The existence of this compound is strong evidence in favor of the pseudometasilicate theory; and, as will be seen later, it does not stand alone. The formulæ as written suggest a close analogy between the pyroxene-amphibole minerals and the olivine group, which may have some future significance.

Among the amphiboles, as among the pyroxenes, aluminous and ferric compounds are common, and with these the minerals approach to orthosilicate ratios. Tschermak's interpretation of these ratios is practically the same as in the pyroxene series, namely, by the assumption of molecules of the form Al_2RSiO_6 or $Al_4R_2Si_2O_{12}$. An alternative to this view is offered by Scharizer,* who shows that the hornblendes can be explained as mixtures of actinolite, $R_4Si_4O_{12}$, with an orthosilicate called syntagmatite $(R'_2R'')_3Al_2(SiO_4)_3$, whose ratios are similar to those of garnet. An amphibole from Jan Mayen's Island approaches very nearly to syntagmatite in composition. If a compound of this type is present in the amphiboles it would explain at once their alterability into epidote, micas, and chlorites; but so far as the composition of the group is concerned neither Tschermak's view nor Scharizer's is absolutely necessary. The Tschermakian molecule, however, can be written either as



or as



the latter form resembling that of tremolite, and also connecting the group still more closely with the olivines. It is also parallel to the last formula suggested for the corresponding pyroxene compound, being one-half of the latter and identical with it in type.

No amphibole is yet known which, by itself, corresponds precisely in its constitution to acmite and spodumene. In glaucophane we find a species, which, as a metasilicate, may be written $AlNaSi_2O_6+(MgFe)SiO_3$; and in crocidolite another similar salt, $Fe'''NaSi_2O_6+FeSiO_3$. Crocidolite alters easily; and one of the products of alteration, which has been named griqualandite, is very near $Fe'''HSi_2O_8$, the equivalent of acmite in general type. This last compound can be written

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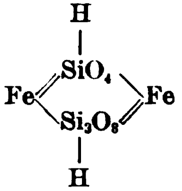
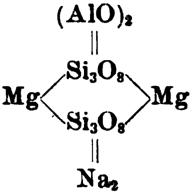
* Neues Jahrbuch, 1884, (2), p. 143.

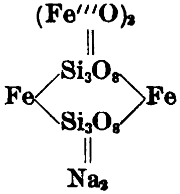


and so adjusted as an amphibole-hydrogen-acmite to the remainder of the group; but glaucophane and crocidolite are best formulated as follows:

Glaucophane.

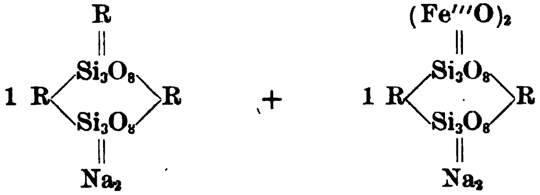


Crocidolite.



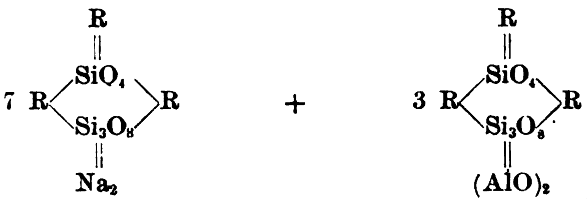
which makes them, as trisilicates, precisely equivalent in structure to the normal amphiboles. These compounds, and their corresponding orthosilicates, commingled with salts like tremolite or actinolite, give mixtures which conform in composition to the aluminous hornblendes.

Closely allied to crocidolite and glaucophane is the recently described amphibole crossite;* in which the ratio of Si:O is distinctly less than 1:3. This species may be written as a mixture of the two molecules



with some Al in place of Fe''', and R being=Fe, Mg, Ca. Gastaldite and riebeckite are similar species, but the analyses are not perfectly conclusive. It is, perhaps, necessary with these minerals to assume the presence of acmite like molecules, riebeckite being empirically near $2Fe'''NaSi_2O_6+FeSiO_3$.

Arfvedsonite, in which R'' is mainly Fe, may be represented quite closely as a mixture of this order:



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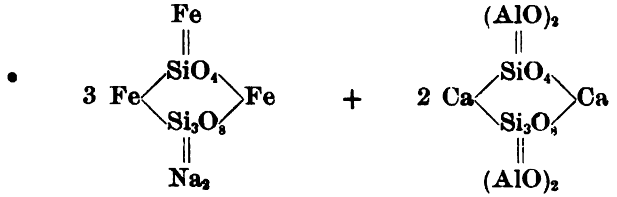
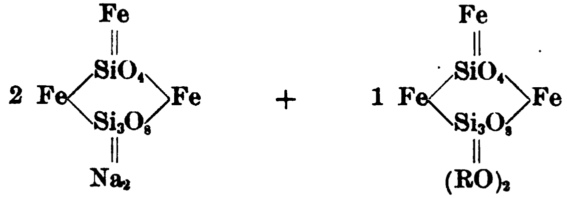
* Palache, Geol. Bulletin, Univ. of California, I, p. 181. 1894.

a little aluminum being replaced by iron. Barkevikite, a more basic species still, has its composition well indicated by the following expression, with some Fe replacing Al as in arfvedsonite:



Finally, in the triclinic aenigmatite, if we assume that the titanium (7.57 per cent TiO_2) is equivalent to silica, we find the mixture



with RO=AlO:FeO::1:1 almost exactly, and Si:Ti::7:1. Calculating with these ratios, ænigmatite has the following composition in comparison with Forsberg's analysis:*

	Found.	Calculated.
SiO_2	37.92	38.11
TiO_2	7.57	7.26
Fe_2O_3	5.81	4.85
Al_2O_3	3.23	3.08
FeO	35.88	39.20
MnO	1.00	
CaO	1.36	
MgO	.33	
Na_2O	6.58	7.50
K_2O	.51	
	100.19	100.00

The variations here are plainly due to the replacements of Fe by Mn, Ca, and Mg, and of Na by K.

A careful study of the best analyses in the pyroxene and amphibole groups will strengthen very materially the view here developed that the species are not true metasilicates. Although in most cases the approximation to metasilicate ratios is very close, there are distinct variations toward orthosilicates on one side and toward trisilicates on the other, and it is only by assuming that we have mixed silicates to deal with that all the anomalies can be made to disappear. On this theory, if we represent Si_3O_8 and SiO_4 groups indiscriminately by the general symbol X, all of the amphiboles are covered by the following typical symbols, in which R'' stands for any dyad metal, and R' for K, Na, H, AlO, or Fe'''O:

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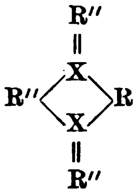
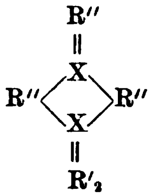
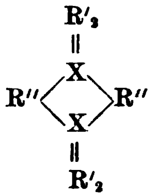
*Zeit. Kryst. Min., XVI, p. 428.

$$R''_4X_2$$
$$R''_3X_2R'_2$$
$$R''_2X_2R'_4$$

or, structurally,

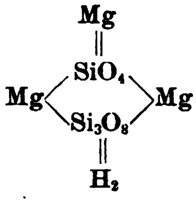




In a similar way, all the pyroxenes, except the acmite-spodumene group, which has the special formula discussed previously, may be represented as formed by mixtures of

$$R''_4X_4R''_4$$
$$R''_4X_4(R'''O)_8$$

which is in accordance with the theory developed by Tschermak except as to the molecular magnitude of the compounds—that is, the pyroxenes are essentially bipolymers of the amphiboles, and the character of the structure is the same for both groups. The olivine minerals are represented by similar orthosilicate formulæ, $R_4(SiO_4)_2$ being the constitutional equivalent of $R_4(SiO_4)(Si_3O_8)$. Pseudomorphs of pyroxene (fassaite) after monticellite, have been found at Monzoni, and are well known. Furthermore, Becke* has described pseudomorphs of anthophyllite and actinolite after olivine, so that a connection between the two groups is clearly indicated. The tracing of this connection in a more general way would seem to offer a profitable field for investigation.

By the hydration of pyroxene or amphibole either serpentine or talc may be generated. The latter species has the composition $H_2Mg_3Si_4O_{12}$, and may be written structurally like amphibole either



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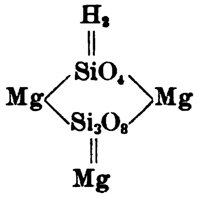

Both expressions are in accord with the fact recorded by Schneider and myself,† that upon the ignition of talc one-fourth of the silica is set free quantitatively. This would give the ignited residue the composition shown by the subjoined alternative formulæ:

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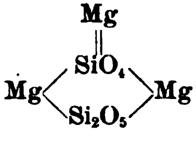
* Min. Pet. Mitth. (N. F.), 4, pp. 355 and 450.

† Bull. U. S. Geol. Survey No. 78, p. 13.



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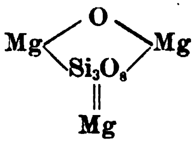
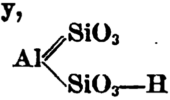


and of these the first would seem to accord the better with the remarkable stability and insolubility of the material. A metasilicate formula, $H_2Mg_3(SiO_3)_4$, is also admissible, and accords equally well with the evidence concerning talc. The pseudometasilicate expression, however, seems to be preferable in view of what is known as to the genesis of the species.

Pyrophyllite and kyanite are two aluminous metasilicates which seem to be related; at all events the former is not infrequently the gangue or matrix of the latter. Empirically they are

Pyrophyllite	$AlHSi_2O_6$
Kyanite	Al_2SiO_5

or, structurally,



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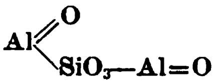
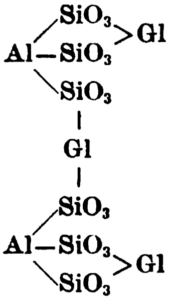
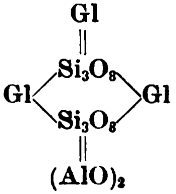


To these formulæ I attach very little significance, except in so far as they represent a single observed relation. Probably the true formulæ should be multiples of these; for kyanite is much denser than its isomer, andalusite, $Al_3(SiO_4)_3(AlO)_3$. Both kyanite and andalusite, at very high temperatures, are transformed, with disengagement of heat, into a third isomer, sillimanite,* a phenomenon which indicates dissociation. Sillimanite doubtless has the smallest molecule of the three species, and may be $Al \equiv SiO_4 - AlO$, but even this is so purely hypothetical that it would be useless at present to discuss the species farther.

With beryl, $Gl_3Al_2Si_6O_{18}$, the evidence in favor of a metasilicate structure is fairly good, although the composition can also be expressed as that of a basic trisilicate. There are thus two alternatives,



and



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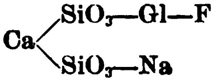
* Vernadsky, Bull. Soc. Min., XII, p. 447, and XIII, p. 256.

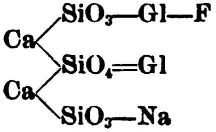
But beryl alters into mica, a fact which is favorable to the first of these formulæ, and all of its commoner alterations seem to take place by replacement of glucinum. In the trisilicate formula the alumina should be equally replaceable, and so far the evidence is adverse to it. Furthermore, Traube* has effected the synthesis of beryl by precipitating a mixture of glucinum and aluminum sulphates with a solution of sodium metasilicate, and then crystallizing by fusion of the precipitate with boron trioxide. Since the starting point was a metasilicate, there is a fair presumption that the product was a metasilicate also. Beryl can be written as a pseudometasilicate, but there are no data to justify doing so.

Two other minerals containing glucinum, leucophanite, and meliphanite, appear to be essentially metasilicates with the subjoined formulæ:

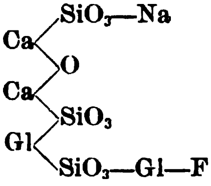
Leucophanite	$NaCaGlFSi_2O_6$
Meliphanite	$NaCa_2Gl_2FSi_3O_{10}$

These are capable of several interpretations. The simplest regards meliphanite as a mixed meta- and orthosilicate, when both species can be written





or else with the glucinum as the linking element, and with the calcium united to fluorine. This involves no change of type, but only an exchange of position between Ca and Gl. Brögger,† to whom the empirical formulæ are due, also represents meliphanite as a basic metasilicate



which is also justifiable. Between the several alternatives there is no ground for deciding. The stability of meliphanite toward ordinary acids would seem to favor the formula first given, for a basic calcium salt would probably be more easily decomposable.

Danburite, $CaB_2Si_2O_8$, is sometimes regarded as the equivalent of barsowite, $CaAl_2Si_2O_8$, a doubtful isomer of anorthite. But barsowite

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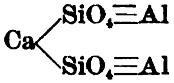
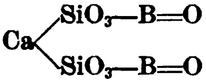
[*] Neues Jahrbuch., 1894, I, p. 275.

[†] Zeit. Kryst. Min., XVI, pp. 289–291.

gelatinizes with hydrochloric acid, while danburite is attacked by the reagent only after ignition. Possibly the difference may be as follows:

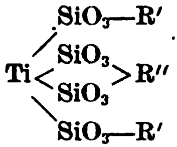




danburite being a metasilicate. Other formulæ are also possible, and more data are needed before any conclusion can be reached. The associations of danburite with feldspars, mica, pyroxene, etc., suggest that it may be a pseudometasilicate, allied in structure to the aluminous constituent of augite.

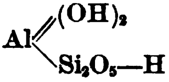
Chrysocolla is probably a metasilicate, and perhaps, empirically, $CuSiO_3.2H_2O$. It can not be well regarded as impure dioptase, for the latter gelatinizes with hydrochloric acid, while chrysocolla does not. The species, which may be a mixture of compounds, needs careful investigation.

Among the titanosilicates, the recently described neptunite* appears to be a meta compound,



with R′=Na, K, and R″=Fe, Mn. The analogy between this formula and the formulæ of the titanium orthosilicates is its sole justification. The ratios given by analysis, however, are sharply in accord with the proposed expression.

The salts which are fairly ascribable to dimetasilicic acid, $H_2Si_2O_5$, are few in number and comparatively rare. Among them, petalite, $AlLi(Si_2O_5)_2$, is the best known and most characteristic. Its formula, as here written, is closely similar to the metasilicate formula for spodumene, and the two species are commonly associated. Petalite, however, has far the lower density of the two, and is therefore presumably composed of smaller molecules. An alteration product of petalite, hydrocastorite, approximates roughly to



which requires

SiO_2	60.60
Al_2O_3	25.75
H_2O	13.65
	100.00

The actual hydrocastorite contains about 4.3 per cent of lime, and is doubtless impure. By Doelter† petalite is interpreted somewhat differently, being given the empirical formula $Al_2Li_2Si_{10}O_{24}$; but the formula here adopted is the one most generally received.

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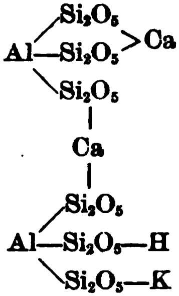
* Flink. Geol. Fören. Förhandl., XV, p. 196.

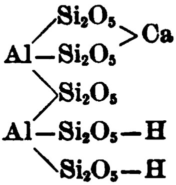
† Min. Pet. Mitth., 1878, I, p. 529.

Milarite, $HKCa_2Al_2(Si_2O_5)_6$, is, like beryl, hexagonal; and its formula is analogously to be written

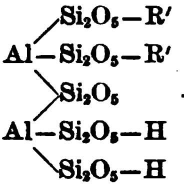


For this species the only evidence is that of its composition. Its genesis and its possible alterations are unknown.

The two closely allied zeolitic minerals, mordenite and ptilolite, are also to be classed as dimetasilicates. Their constitution, which I have fully discussed elsewhere,* is easily expressed by regarding both minerals as mixtures of the two molecules



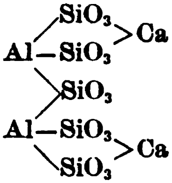
$+6H_2O$ and



$+6H_2O$

in which $R' = Na$ or K. In one occurrence of ptilolite the water is lower than is required by these formulæ, and it seems probable that a trihydrate may exist.

The metasilicate zeolite, laubanite, is the precise equivalent of ptilolite and mordenite, and is easily interpreted thus:



$+6H_2O$

Pilinite, a similar mineral, seems to be $Al_2(SiO_3)_5Ca_2.H_2O$, a monohydrate corresponding to the hexhydrated laubanite. Unlike laubanite, pilinite is undecomposed by hydrochloric acid; but physically all four of the species here grouped together resemble one another very closely.

The rare mineral hyalotekite, which contains boron, agrees very closely with the empirical formula $R''_4BFSi_6O_{17}$, if we regard the water in it as hydroxyl replacing fluorine. This can be interpreted either as a dimetasilicate or as a trisilicate, with the following alternative formulæ:

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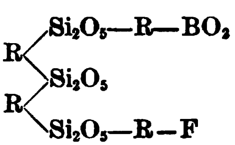
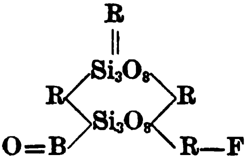
* Am. Jour. Sci., August, 1892.



or



Its association with feldspar and schefferite rather favors the trisilicate formula, but the two are empirically identical. If we reduce Lindström's analysis to 100 per cent, after calculating the water (ignition) into its equivalent of fluorine, rejecting as impurities the traces of Al_2O_3 and Fe_2O_3, and consolidating like bases, we get the following comparison with theory:

	Found.	Reduced.	Calculated.
SiO_2	39.47	38.60	38.10
B_2O_3	3.73	3.63	3.71
PbO	25.11	25.71	26.22
CuO	.09		
MnO	.29		
GlO	.75		
Na_2O	.17		
CaO	7.82	9.43	9.22
BaO	20.08	21.32	21.59
MgO	.09		
K_2O	.89		
Al_2O_3	.18	....	....
Fe_2O_3	.06	....	....
F	.99		
Cl	.06	2.26	2.01
Ign	.59		
	100.37	100.95	100.85
Less O	....	.95	.85
		100.00	100.00

In computing, R″ has been regarded as Ca:Ba:Pb::7:6:5—that is, hyalotekite is a mixture of isomorphous calcium, barium, and lead salts in the indicated ratio. The agreement between analysis and theory is as close as could be reasonably expected.

There still remain a few natural silicates which are definitely recognized as species, but which do not fall distinctly into any one of the chapters of this work. Their constitution is obscure, and I shall not attempt to discuss them. Still, they may properly be recorded at this point for the sake of completeness.

Cuspidine.—A fluosilicate of calcium, supposed to be orthosilicate in structure. It may be allied to chondrodite, but it has not yet been completely analyzed.

Långbanite.—A silicate of manganese and iron containing antimony. Allied on crystallographic grounds to the oxides hematite and ilmenite.

Uranophane.—Composition represented by the empirical formula $CaU_2Si_2O_{11}.6H_2O$.

Thaumasite.—$CaSiO_3,CaSO_4,CaCO_3,15H_2O$. To the molecular constitution of this extraordinary substance there is as yet no tangible clew. A structural formula can be assigned to it, but would be meaningless.

Neotocite.—Hydrous silicates of manganese and iron, of variable composition. Several distinct compounds are probably covered by this name.

A multitude of other silicates have been described as species, but without, as yet, securing full recognition. Some of these are doubtless mixtures, or impure varieties of well known minerals; while others may be ultimately established as good and definite compounds. A discussion of the records, without experimental investigation of the various minerals, would have very uncertain value. I therefore omit these doubtful species from consideration.

CHAPTER VIII.

SUMMARY.

The formulæ developed in the body of this memoir are so varied and so interlinked, one with another, that a summary of them in concise form seems to be desirable. I accordingly append such a summary, with occasional notes intended to make the subject, if possible, more clear.

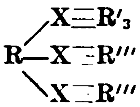
1. *Ortho- and trisilicates of triad bases.*

A. Normal salts.

Xenolite	$Al_4(SiO_4)_3$(?)
Samoite	$Al_4(SiO_4)_3.10H_2O$(?)
Cimolite	$Al_4(Si_3O_8)_3.6H_2O$(?)
Anthosiderite	$Fe_4(Si_3O_8)_3.2H_2O$(?)
Pseudobrookite	$Fe_4(TiO_4)_3$
Eulytite	$Bi_4(SiO_4)_3$
Agricolite	

Of these species the last three are definitely established, but the others are more or less uncertain.

B. First substitution series.

Type 

$$R\begin{cases} X\equiv R'_3 \\ X\equiv R''' \\ X\equiv R''' \end{cases}$$

Eucryptite	$Al_3(SiO_4)_3Li_3$
Nephelite	$Al_3(SiO_4)_3Na_3$
Kaliophilite	$Al_3(SiO_4)_3K_3$
Kryptotile	$Al_3(SiO_4)_3H_3$(?)
Albite	$Al_3(Si_3O_8)_3Na_3$
Orthoclase	$Al_3(Si_3O_8)_3K_3$
Paragonite	$Al_3(SiO_4)_3NaH_2$
Muscovite	$Al_3(SiO_4)_3KH_2$
Andalusite	$Al_3(SiO_4)_3(AlO)_3$
Sillimanite	
Topaz	$Al_3(SiO_4)_3(AlF_2)_3$
Kornerupine*	$Al_3(SiO_4)_3(AlO_2Mg)_3$
Rectorite	$Al_3(SiO_4)_3H_3.2H_2O$(?)
Hydronephelite	$Al_3(SiO_4)_3Na_2H.3H_2O$

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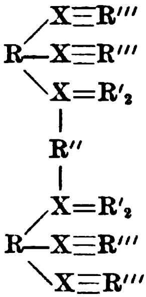
*Doubtful. Compare with formulæ given for pyroxenes and amphiboles.

Offretite	$\left[\begin{array}{l}2Al_3(Si_3O_8)_3K_2H.8H_2O\\1Al_3(SiO_4)_3CaH.8H_2O\end{array}\right]$
Gmelinite	$Al_3(SiO_4)(Si_3O_8)_2Na_3.9H_2O$
Soda chabazite	$Al_3(SiO_4)(Si_3O_8)_2Na_3.9H_2O$

Double type

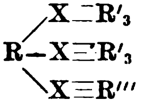


Anorthite	$Al_6(SiO_4)_6Ca_3$
Meionite	$Al_6(SiO_4)_6Ca_2.(CaOCa)$
Thomsonite	$Al_6(SiO_4)_6Ca_3.7H_2O$
Gismondite	$Al_6(SiO_4)_6Ca_3.12H_2O$
Phillipsite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_2K_2.14H_2O$
Levynite	$Al_6X_6Ca_3.15H_2O$
Heulandite	$Al_6(Si_3O_8)_6Ca_3.16H_2O$
Epistilbite	$Al_6(Si_3O_8)_6Ca_3.16H_2O$
Stilbite	$Al_6(Si_3O_8)_6Ca_3.18H_2O$
Chabazite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_3.18H_2O$

Also the barium feldspars, and the barium-strontium zeolites harmotome and brewsterite. X represents the tetrad groups SiO_4 and Si_3O_8 indiscriminately.

C. Second substitution series.

Type



Natrolite	$Al_2(SiO_4)_3Na_2H_4$
Dumortierite	$Al_2(SiO_4)_3(AlO)_6$
Zunyite	$Al_2(SiO_4)_3R'_6$
Chloropal	$Fe_2(SiO_4)_3H_6$
Cancrinite	$Al_2(SiO_4)_3Na_4H(AlCO_3)$
Microsommite	$Al_2(SiO_4)_3CaR'_4$
Prehnite	$Al_2(SiO_4)_3Ca_2H_2$
Arctolite	$Al_2(SiO_4)_3CaMgH_2$
Biotite	$Al_2(SiO_4)_3Mg_2KH$
Siderophyllite	$Al_2(SiO_4)_3Fe_2KH$
Biotite-vermiculite	$Al_2(SiO_4)_3Mg_2H_2.3H_2O$
Biotite-chlorite	$Al_2(SiO_4)_3(MgOH)_4H_2$
Scolecite	$Al_2(SiO_4)_3CaH_4.H_2O$
Sodalite	$Al_2(SiO_4)_3Na_4(AlCl)$

Haüynite	$Al_2(SiO_4)_3Na_2Ca(AlSO_4Na)$
Nosite	$Al_2(SiO_4)_3Na_4(AlSO_4Na)$
Lazurite	$Al_2(SiO_4)_3Na_4(AlS_3Na)$
Garnet group	$R'''_2(SiO_4)_3R''_3$
Epidote group	$R'''_2(SiO_4)_3R''_2(R'''OH)$
Leucite	$Al_2(SiO_4)(Si_3O_8)_2K_4(AlSiO_4Al)$
Analcite	Similar to leucite.
Pollucite	Similar to leucite.
Marialite	$Al_2(Si_3O_8)_3Na_4(AlCl)$

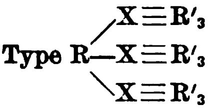
Double type, $R'''_4X_6R''_6$.

Mesolite	$Al_4(SiO_4)_6CaNa_2H_8.H_2O$
Foresite	$Al_4(SiO_4)_6CaH_{10}.H_2O$

Conjugate type, $R'''_2X_5R''_7$.

Vesuvianite	$Al_2(SiO_4)_5R''_6(AlOH)$
Gehlenite	$Al_2(SiO_4)_5R''_6(AlO_2Mg)_2$
Melilite	$Al_2(SiO_4)_4(SiO_3)R''$

D. Third substitution series.



$$\text{Type } R\begin{array}{l} \diagup X\equiv R'_3 \\ —X\equiv R'_3 \\ \diagdown X\equiv R'_3 \end{array}$$

Phlogopite	$Al(SiO_4)_3Mg_3KH_2$
Phlogopite-vermiculite	$Al(SiO_4)_3Mg_3H_3.3H_2O$
Phlogopite-chlorite	$Al(SiO_4)_3(MgOH)_6H_3$
Manganophyll	$(AlFe)(SiO_4)_3(MnMg)_3KH_2$
Ganophyllite	$AlX_3Mn_3R'_3.2H_2O$
Stilpnomelane	$Al(Si_3O_8)_3(FeOH)_6H_3$
Faujasite	$Al(Si_3O_8)_3R'_5R''_2.15H_2O$
Cerite	$Ce(SiO_4)_3(CeO)_3H_6$

Double type, $R'''_2X_6R'_{18}$.

Staurolite	$Al_2(SiO_4)_6Fe''_3(AlO)_{12}$
Harstigite	$Al_2(SiO_4)_6Ca_5Mn_2H_4$

E. Basic salts.

Westanite	$AlOH(SiO_4)_2Al_2$
Kaolin	$AlOH(SiO_4)_2AlH_3$
Montmorillonite	$AlOH(SiO_4)_2H_6$
Newtonite	$Al(OH)_2(SiO_4)H_3$
Margarite	$AlOH(SiO_4)_2CaH(AlO)_3$
Strigovite	$AlOH(SiO_4)_2AlH(FeOH)_2$
Aphrosiderite	$AlOH(SiO_4)_2Al(FeOH)_3$
Lepidolite type	$AlF_2(Si_3O_8)R'_3$
Cookeite type	$Al(OH)_2(SiO_4)R'_3$
Clintonite type	$AlO_2Mg(SiO_4)R'_3$
Clintonite-vermiculite	$AlO_2Mg(SiO_4)R'_3.3H_2O$
Chloritoid	$AlO_2Fe(SiO_4)H(AlOH)$
Ottrelite	$AlO_2Fe(Si_3O_8)H(AlOH)$

With many members of the chlorite group, such as prochlorite, leuchtenbergite, etc.

F. Borosilicates, etc.

Tourmaline, A	$Al_8(SiO_4)_6(BO_3)(BO_2)_2R'_5$
Tourmaline, B	$Al_7(SiO_4)_6(BO_3)(BO_2)_2Mg_2R'_4$
Tourmaline, C	$Al_6(SiO_4)_6(BO_3)(BO_2)_2Mg_3R'_5$
Tourmaline, D	$Al_5(SiO_4)_6(BO_3)(BO_2)_2Mg_4R'_6$
Axinite	$Al(SiO_4)(Si_3O_8)(BO_3)Ca_3(AlOH)$

And the species cappelinite, karyocerite, melanocerite, and tritomite.

G. Complex silicates.

Spodumene	$Al_6(Si_3O_8)_3(SiO_4)_3Li_6$
Jadeite	$Al_6(Si_3O_8)_3(SiO_4)_3Na_6$
Acmite	$Fe_6(Si_3O_8)_3(SiO_4)_3Na_6$
And in babingtonite the molecule	$Fe'''_6(Si_3O_8)_3(SiO_4)_3Fe''_3$

To this group of triad silicates, the largest and most important group of all, other species belong which I have not clearly interpreted. Such species are halloysite, allophane, collyrite, schrötterite, sapphirin, ardennite, carpholite, cenosite, sarcolite, etc. The formulæ of the tabulated species must all be construed in a general way—that is, with common replacements of aluminum by ferric iron, magnesium by ferrous iron, and so on. In every case details are suppressed, and these are to be found in the text. The same rule applies to the species in the groups which follow:

2. *Ortho- and trisilicates of dyad bases.*

Forsterite	$n.Mg_2SiO_4$
Fayalite	$n.Fe_2SiO_4$
Tephroite	$n.Mn_2SiO_4$
Willemite	$n.Zn_2SiO_4$
Phenakite	$n.Gl_2SiO_4$
Monticellite	$CaMgSiO_4$
Knebelite	$MnFeSiO_4$
Hyalosiderite	$Mg_4Fe_2(SiO_4)_3$
Igelströmite	$Fe_4Mn_2(SiO_4)_3$
Trimerite	$Gl_3Mn_2Ca(SiO_4)_3$
Chondrodite	$Mg_3(SiO_4)_2(MgF)_2$
Humite	$Mg_5(SiO_4)_3(MgF)_2$
Clinohumite	$Mg_7(SiO_4)_4(MgF)_2$
Helvite Danalite	$Gl_3R''_2(SiO_4)_3(R—S—R)$
Bertrandite	$Gl_3(SiO_4)_2H(GlOH)$
Calamine	$Zn_2(SiO_4)_2H_2(ZnOH)_2$
Lievrite	$Fe_2Ca(SiO_4)_2(AlOH)$
Datolite	$Ca_2(SiO_4)_2H_2(BO)_2$
Homilite	$Ca_2Fe(SiO_4)_2(BO)_2$

Euclase	$Gl_2(SiO_4)_2H_2(AlO)_2$
Gadolinite	$Gl_2Fe(SiO_4)_2(YO)_2$
Friedelite	$R''_4(SiO_4)_4H_7(R''Cl)$
Pyrosmalite	
Dioptase	$n.CuH_2SiO_4$
Karyopilite	$Mn_3(SiO_4)_3H_5(MnOH)$
Villarsite	$Mg_3(SiO_4)_2H(MgOH)$
Serpentine	$Mg_2(SiO_4)_2H_3(MgOH)$
Picrosmine	$Mg_2(SiO_3)(SiO_4)H_2$
Aphrodite	$Mg_2(SiO_4)_2H_4$
Kerolite	$Mg(SiO_4)_2H_5(MgOH)$
Deweylite	$Mg_2(SiO_4)_3H_6(MgOH)_2.2H_2O$
Eudidymite	$HNaGlSi_3O_8$
Epididymite	

3. *Ortho- and trisilicates of tetrad bases.*

Zircon	$n.ZrSiO_4$
Thorite	$n.ThSiO_4$(?)
Auerbachite	$Zr_4(SiO_4)_3(Si_3O_8)$
Malacone	$Zr_3(SiO_4)_3(OH)H$
Eudialyte	$ZrX_3Cl.Ca_3Na_3$
Elpidite	$Zr(Si_3O_8)_2(OH)_2Na_2H_4$
Catapleiite	$Zr(Si_3O_8)(OH)_3Na_3$
Wöhlerite	$Zr(SiO_4)_4R''_5Na_2$
Yttrialite	$Th(Si_3O_8)_4Fe''_2(YO)_8$
Astrophyllite	$Ti(SiO_4)_4Fe''_4R'_4$
Johnstrupite	$Ti(SiO_4)_4Ca_4(CeF_2)Na_2H$
Sphene	$Ca(SiO_4)(TiO)$

With rosenbuschite, låvenite, and hiörtdahlite, allied to wöhlerite; rinkite and mosandrite, allied to johnstrupite; and keilhauite and tscheffkinite, allied to sphene.

4. *The diorthosilicates.*

Barysilite	$Pb_3(Si_2O_7)$
Melanotekite	$Pb_2(Si_2O_7)(Fe'''O)_2$
Kentrolite	$Pb_2(Si_2O_7)(Mn'''O)_2$
Ganomalite	$(PbCa)_3(Si_2O_7)$
Okenite	$Ca_3(Si_2O_7)_3H_{12}$
Gyrolite	$Ca_4(Si_2O_7)_3H_{10}$
Apophyllite	$Ca_2(Si_2O_7)_3H_{12}(CaOH)_2$
Plombierite	$Ca_6(Si_2O_7)_3H_6.\ 9H_2O$
Inesite	$R_6(Si_2O_7)_3H_6.\ 2H_2O$
Bementite	$Mn_6(Si_2O_7)_3H_6$
Spadaite	$Mg_5(Si_2O_7)_3H_8$
Saponite	$(MgOH)_2H_4(Si_2O_7)$.(?)
Iolite	$Al_6(Si_2O_7)_5Mg_4(AlOH)_2$

Barylite	$Al_4(Si_2O_7)_3Ba_3$
Sphenoclase	$Al_2(Si_2O_7)_3Ca_6$
Rowlandite	$Fe''(Si_2O_7)_2Y_2(YF)_2$

5. *The metasilicates.*

Laubanite	$Al_2(SiO_3)_5Ca_2.6H_2O$
Talc*	$Mg_3(SiO_3)_4H_2$(?)
Pyrophyllite	$Al(SiO_3)_2H$
Kyanite	$AlO(SiO_3)(AlO)$
Beryl	$Al_2Gl_3(SiO_3)_6$
Leucophanite	$Ca(SiO_3)_2Na(GlF)$
Meliphanite	$Ca_2(SiO_3)_2(SiO_4)GlNa(GlF)$
Wollastonite	$Ca_3(SiO_3)_3$
Pectolite	$Ca_2(SiO_3)_3NaH$
Danburite	$Ca(SiO_3)_2(BO)_2$
Chrysocolla	$CuSiO_3.2H_2O$(?)
Neptunite	$Ti(SiO_3)_4R''R'_2$

Leucite, pollucite, analcite, eudialyte, etc., have been treated as pseudometasilicates. To these species must be added the pyroxenes and the amphiboles, with the following general formulæ:

Pyroxene	$R''_8(SiO_4)_2(Si_3O_8)_2$
Amphibole	$R''_4(SiO_4)(Si_3O_8)$

Glaucophane and crocidolite may be written

$$R''_2(Si_3O_8)_2(R'''O)_2Na_2$$

or all trisilicate, and crossite, waldheimite, etc., seem to be similar. The evidence for these expressions appears in the text.

6. *The dimetasilicates.*

Petalite	$Al(Si_2O_5)_2Li$
Milarite	$Al_2(Si_2O_5)_6HKCa_2$
Mordenite	$Al_2(Si_2O_5)_5CaH_2.6H_2O$
Ptilolite	$Al_2(Si_2O_5)_5R'_2H_2.6H_2O$
Hyalotekite	$R''_2(SiO_5)_3(RF)(RBO_2)$

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* Possibly a pseudometasilicate.

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CHARLES D. WALCOTT, DIRECTOR

A
MINERALOGICAL LEXICON
OF
FRANKLIN, HAMPSHIRE, AND HAMPDEN COUNTIES MASSACHUSETTS

BY

BENJAMIN KENDALL EMERSON

WASHINGTON
GOVERNMENT PRINTING OFFICE
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LETTER OF TRANSMITTAL.

AMHERST, MASS., *December 20, 1894.*

SIR: I have the honor to transmit herewith, for publication as a bulletin of the United States Geological Survey, a mineralogical lexicon of Franklin, Hampshire, and Hampden counties, Mass. This lexicon was prepared to accompany a monograph on the geology of this area, but it has seemed desirable to present it for separate publication.

Very respectfully,

BEN. K. EMERSON.

Hon. C. D. WALCOTT,
Director United States Geological Survey.

A MINERALOGICAL LEXICON OF FRANKLIN, HAMPSHIRE, AND HAMPDEN COUNTIES, MASS.

By B. K. EMERSON.

INTRODUCTION.

The purpose of this bulletin is to give a condensed history of each mineral species occurring within the area of the three river counties in Massachusetts. Each citation from the original documents is placed in its proper chronological order under the present name of the mineral to which it refers, and the minerals are arranged alphabetically. In all important cases synonyms, incorrect references, and pseudomorphs are entered in their alphabetical places with cross references to the places where they belong and are fully discussed. When citations are given verbatim, they are inclosed within quotation marks, and when corrections or additions are made to a citation by the author they are inclosed in parentheses. Descriptions, analyses, and remarks unquoted are by the author. In several cases of special interest pseudomorphs, especially those containing several minerals, are entered separately under the names by which they have been described—as hampshirite, cymatolite. Where the mineral was first discovered in this region the author's name is placed in parentheses after the name of the mineral.

The work was prepared as a chapter of a forthcoming monograph upon the geology of the three river counties, but became so large that it seemed best to publish it separately. For this reason many minerals, especially those of lithological interest, are fully discussed in the monograph, and only that portion of their history which is of special mineralogical importance is detailed here.

It has been my purpose to bring out fully the work of the pioneers, and I had added to the monograph a chapter on the history of geological and mineralogical discovery in the valley, which might almost as well have found place here, since the early studies were in the main mineralogical.

Special attention has been given to the genesis, paragenesis, exact locality, and geological position of each occurrence.

In the following table the full column of the geological formations present in the area is given as established in the monograph.

All the minerals are referred to their proper place in this column.

Synonyms.		Equivalents along the eastern border of the area and in Worcester County.
	PLEISTOCENE.	
	Terrace gravels, sands, and clays. *Champlain clays.* *Glacial bowlder-clays.*	
	TRIASSIC.	
	The Sugar Loaf arkose, or feldspathic sandstone. *The Mount Toby conglomerate.* *The Long Meadow brownstone*, or fucoidal sandstone. *The Granby tuff*, or diabase ash beds. *The Holyoke and Deerfield diabase beds*, or the trap.	
	DEVONIAN.	
	Bernardston series. 1. Mica-schist and gneiss. 2. Amphibolite. 3. Quartzite, with limestone beds carrying fossils.	
	SILURIAN.	
Clay-slate. Calciferous mica-schist. Spangled slates (Hitchcock).	*Conway schist*, with beds of limestone and amphibolite. *Goshen schist*, with beds of quartzite.	Brimfield fibrolite schist.
Talcose slates, or talcoid slates. Hydromica-schists (Dana).	*Hawley schist*, with beds of amphibolite and iron ores. *Savoy schist*, with beds of amphibolite. *Chester amphibolite*, with beds of saxonite, serpentine, steatite, emery, and magnetite. *Rowe schist*, with amphibolite beds. *Hoosac schist* (upper part).	Hardwick gneiss and Paxton quartz schist.
	CAMBRIAN.	
	Hoosac schist (lower part). *Becket gneiss.*	Monson and Pelham gneiss.
	PRE-CAMBRIAN.	
	Washington gneiss. *Lee gneiss.* *Hinsdale limestone.*	

LEXICON.

ACMITE.

1841. **Acmite.** Chester. See Tourmaline.

E. Hitchcock: Geol. Mass., 1841, p. 614.

ACTINOLITE.

See Amphibole.

AGLAITE.

1877. **Aglaite.** (Julien.) Chesterfield.

A. A. Julien: Synonym of cymatolite; a pseudomorph after spodumene. See ALBITE, 1877. (Name never used.)

ALBITE.

1817. **Kieselspath.** Chesterfield.

G. F. L. Hausmann: Göttinger Gelehrte Anzeigen, p. 1401.

1819. **Siliceous feldspar.** Chesterfield, Goshen.

"When I first examined this rock, soon after its discovery by Dr. Hunt in Northampton, I determined the feldspar to be a new variety, which has since been confirmed by Professor Hausmann, and now ranks as a new subspecies, under the name of siliceous feldspar." A full and accurate description of the mineral follows:

An analysis of Stromeyer is given:

SiO_2	70.68
Al_2O_3	19.80
NaO	9.06
CaO FeO MgO	.38
	99.91

On the Tourmalines, etc.; G. Gibbs: Am. Jour. Sci., 1st series, Vol. I, p. 346.

1820. **Siliceous spar.**

"Soon after Dr. Hunt discovered this mineral, Colonel Gibbs pronounced it a new one."

A. Eaton: Index, p. 121.

1821. **Kieselspath.** Chesterfield.

Analyzed at request of Hausmann:

SiO_2	70.68
Al_2O_3	19.80
NaO	9.06
CaO	.23
FeO (MnO)	.11
	99.88

The analysis cited above by Gibbs is also given.

M. Stromeyer: Chemische Untersuchungen, Göttingen, p. 307.

1823. **Siliceous feldspar.** (Gibbs.) Chesterfield.

"Also at Goshen—a new variety discovered by Dr. Hunt."

E. Hitchcock: Geol. Connecticut River, Am. Jour. Sci., 1st series, Vol. VI, p. 221.

1823. **Cleavelandite.** (H. J. Brooke.) Chesterfield.

Brooke: Annals Philos., Part II, Vol. V, p. 381.

1824. **Kieselspath.** Chesterfield.

Stromeyer's analysis quoted. "It is plain that this mineral is a species of feldspar with a base of soda."

Editor's note: Am. Jour. Sci., 1st series, Vol. VII, p. 370.

1824. **Siliceous feldspar.** Chester, Chesterfield.

"Bluish white, laminæ often curved, and sometimes of a stellular form. Abundant at Chester (Emmons). It is probably in the same bed as that at Chesterfield."

C. Dewey: Geol. and Min. of part of Massachusetts; Am. Jour. Sci., 1st series, Vol. VIII, p. 43.

1824. **Albite.** Chesterfield, Chester.

"The siliceous feldspar of Chesterfield passes into a granular variety almost exactly resembling the albite of Sweden. In Chester it is fine and coarse granular."

C. Dewey: Loc. cit., p. 43.

1835. **Feldspar (Albite?).** Middlefield.

"In loose masses lining small cavities in a rock made up of hornblende, augite, and masses of feldspar."

C. U. Shepard: Min. Vol. II, Part I, p. 203.

1836. **Albite.** Chesterfield.

Analysis by Laurent and Holms:

SiO_2	68.4
Al_2O_3	20.8
Fe_2O_3 } Al_2O_3 }	.1
CaO	.2
NaO	10.5
	100.0

Ann. de Chimie, Vol. LX, p. 331; Am. Jour. Sci., 1st series, Vol. XXX, p. 381.

1841. **Albite.** Goshen, Chesterfield, Norwich, New Salem.

Goshen, Chesterfield, foliated and granular; Norwich, foliated and light-blue; New Salem, white foliated; also Chester.

E. Hitchcock: Geol. Mass., p. 703.

1844. **Albite.** (*Spatum triclinatum.*) Chesterfield. Goshen (cleavelandite).

J. D. Dana: Sys. Min. p. 352.

1882. **Albite.** Greenfield.

In the cavities in the amygdaloid, from the shores of the Connecticut, opposite Turners Falls, which are often only partly filled with the vermiform diabantite, and out of which the latter may be shaken as a deep-green powder, there occur minute crystals loosely seated upon the diabantite, or in the powder shaken out from the cavities and scarcely attached at all. They are 0.005-0.01 mm. in diameter, transparent, perfectly fresh crystals, twinned in accordance with the albite law. They are combinations of the form $\infty P \breve{\infty}$, $0 P$, $\infty \breve{P} 3$, $\infty \breve{P} \breve{3}$, $\infty P'$, $\infty {}'P$, $\infty \bar{P} \infty$, $2 \bar{P} \infty$, flattened by the large development of $\infty \breve{P} \infty$ and much elongated in the direction of the axis $\breve{a}$, by one end of which they are uniformly attached. Examined with the polarizing microscope the line of extinction on the face $0 P$ makes with the edge $0 P \wedge \infty \breve{P} \infty$ an angle of +4° to +4° 30′. When lying upon the face $\infty \breve{P} \infty$ the minute twins gave varying results.

When placed in a delicately graduated Thoulet's fluid, so prepared that orthoclase will rest near the surface and labradorite near the bottom, the crystals found the exact level of fragments of transparent albite from Haddam, sp. gr. 2.62, and remained attached to them as if they were so delicately freed from outward attraction that they gravitated toward one another. Some of the crystals having diabantite adherent to them sank to the level of quartz, sp. gr. 2.64, but all were separated by a broad interval from the other triclinic feldspars. The position of these crystals is interesting from a paragenetic point of view. The cavities are tapestried on all sides by the diabantite and the albite crystals rest upon it, often very loosely, and while forming they projected freely into the interior, as is shown by their glassy clearness and perfection of form and polish. The last of the diabantite seems sometimes to fill the cavities into which the albites project, but this could not be ascertained with certainty. As the albite probably demands elevated temperature and increased pressure for its formation, the diabantite upon which it rests must be assigned to the time following immediately the consolidation of the lava, while its heat still intensified the chemical activity of the water it contained.

B. K. Emerson: The Deerfield dyke and its Minerals; Am. Jour. Sci., 3d series, Vol. XXXIV, p. 201.

1882. **Cleavelandite.** Chesterfield, Goshen, Northfield.

Still occurs in greatest abundance and beauty at Clarks Ledge, in Chesterfield; also at the spodumene locality at West Chesterfield Hollow, and at the colored tourmaline locality at the Barras farm, in Goshen, and at a new locality on the top of Strowbridge Hill, in Northfield. This is a mile south of the spodumene locality in the farmyard of Mr. M. A. Browne, in the southwest corner of Winchester, N. H., and is apparently in the prolongation of the same pegmatite dike.

1885. **Cleavelandite.** Huntington.

In blasting for spodumene fine specimens were obtained on Norwich Hill, though not abundantly, with the spodumene, but I found no colored tourmalines with it, although the black tourmaline occurs in large masses.

1885. **Albite.** South Hadley.

From diabase on road north from Moodys Corners, South Hadley. Crystals, 4 mm. long, 2 mm. wide, 2 mm. thick, 0, $\infty P \breve{\infty}$, $\infty {}'P'$, twinned parallel to $\infty P \breve{\infty}$ and elongate parallel to $\breve{a}$; slice cut parallel to $\infty P \breve{\infty}$ (M) gave extinction +20°.

1886. **Albite.** Northampton.

In veins in the granite at a quarry south of W. N. Moore's east of Florence, as hollow incrustations—pseudomorphs after laumonite. The hollow forms show on both outside and inside fine drusy surfaces of fresh, limpid, much-twinned crystals. Extinction on M 18° 45′—19°. (This pseudomorph has been cited only from Scotland by J. R. Blum: Dritter, Nacht. zu den Pseudomorphosen, 1863, Erlangen, p. 67.)

1891. **Periklin.**

Appears (1) in fine large crystals in cavities in the sericite schists at various places in Chester; (2) in hornblende-schist, adjoining granite, east of the soapstone quarry in North Blandford; (3) in fissures in crushed argillite, in Whately; (4) in crystals over an inch long, opaque white, with polished surfaces, closely resembling the forms from the Tyrol, at Ice Rock, a mile below the village of Shelburne Falls, on the river.

For albite-muscovite pseudomorphs after spodumene, see Cymatolite.

ALLANITE.

1841. **Rutile.** Northampton and Williamsburg.

"Associated with quartz in the sienite is a mineral crystallizing in four-sided prisms, which I have been disposed to refer to rutile." (The sienite is the same as the tonalite mentioned below.)

E. Hitchcock: Geol. Mass., p. 677.

1876. **Allanite.** Pelham, Ware, Becket.

C. U. Shepard: Catalogue of Minerals within 75 miles of Amherst, p. 7.

1876. **Allanite.** Hatfield, Pelham, Gilbertville, Buckland.

It is a constant accessory constituent of the Hatfield tonalite and is quite abundant in the granular anorthite at the Pelham asbestos quarry. The crystals are here one-twelfth to one-half inch across, and 1 to 2 inches long. Some crystals are bordered by a dark-brown layer 1 mm. thick and cleaving parallel to a plane rectangular to the prism, which latter shows a varnished surface when the outer layer is removed. A marked puckering of the feldspar surrounds the prisms of allanite.

Certain crystals are deep bottle-green in longitudinal section, black in transverse. Under the microscope the Pelham allanite in cross-section about at right angles to c is clear and free from fissures. It shows a clear dichroism in two shades of red-brown and undulose polarization in stellate bands of shade radiating from several points. It shows no border growth except a fringe of sagenitic rutile, and no decomposition.

It occurs also in the Pelham gneiss (in which the peculiar anorthite-olivine lens, generally cited as the asbestos quarry, is included) at the agricultural college quarry, in the north part of the town. It appears here in the small pebble-like "augen" of orthoclase, which are strung along certain lamination planes in small square prisms, changed generally into a red-brown hydrated variety. A radiated puckering of the feldspar surrounds each crystal. The finest crystals occur at Gilbertville, near Ware, in coarse granite—flattened prisms 2 inches long and a half inch wide, with corroded and varnished surfaces.

In Buckland, on the hilltop a few rods south of Harris's soapstone quarry; as usual, superficially decomposed to a red substance.

1894. **Allanite**. Pelham.

The well-known asbestos mine in Pelham, Mass., is opened on a great dike of black olivine-enstatite rock inclosed in gneiss. The metamorphism which changed the Cambrian conglomerate into gneiss changed the olivine rock, along a network of fissures, into anthophyllite, arranged in transverse fibers, meeting in a suture—a macroscopic olivine network.

A macroscopic "reaction rim" was produced between the two rocks by the interaction of the very basic and the very acid members. Against the olivine rock is a broad band, characterized by very basic minerals—thick bands of biotite, containing apatite, and fine large corundum crystals. Then comes anorthite full of allanite, rutile, and tourmaline in large masses. Then the anorthite graduates into andesite, and this, by the gradual appearance of quartz, microcline, and biotite, into the common, well-bedded gneiss.

A crystal of corundum was shown—largely fine-blue sapphire, in which was a crystal of allanite a half inch across, which had coerced the corundum into a fine radiated puckering nearly an inch wide, outside of which the fine cleavage of the corundum asserted itself. The same puckering surrounds the allanite in the massive anorthite.

B. K. Emerson: Bull. Geol. Soc. Am., VI, p. 474.

ALLOPHANE.

1868. **Allophane.** Greenfield.

White and greenish; in sandstone quarry one-half mile east of village of Greenfield.

J. D. Dana: Min. Localities, Treatise, p. 769.

1880. **Allophane.** Belchertown.

In greenish coating on pink feldspar veins; in hornblende-schist at Kelleys Crossing, in Belchertown.

AMESITE.

1876. **Amesine** (nov. sp.?). (Shepard.) Chester emery mine.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst, p. 4.

(Named after Mr. James T. Ames, of Chicopee, part owner of the emery mine.)

1876. **Amesite**. Chester.

"M. Shepard a donné ce nom à un minéral qui se trouve sur du diaspore à Chester et qui resemble comme couleur et comme éclat au talc vert du Tyrol, ou bien à certaines chlorites du Piémont; il rappelle aussi l'aspect de la pyrosclérite de l'île d'Elbe, quoique sa couleur soit plus pâle (Desc.). H. 2.5–3.0 gr. 2.71, op. ax. positive.

"SiO_2	21.40
"Al_2O_3	32.30
"FeO	15.80
"MgO	19.90
"H_2O	10.90

"C'est donc une espèce distincte."

M. F. Pisani: Notices Minéralogiques; Compte Rendu, Vol. LXXXIII, p. 166.

1882. **Amesite.**

"Apparently identical with corundophyllite."

E. S. Dana: 3d Appendix to 5th ed. Dana's Min., p. 31.

(Professor Shepard has never published any description of the mineral.)

1885. **Amesite.**

The corundophyllite, which is the oldest mineral in the veins where it occurs, forming on each wall a selvage against the magnetite, changes in specimens I have recently obtained into the pale whitish-green amesite; so that there can be no doubt of the derivation of the one from the other. The typical specimens of amesite labeled by Professor Shepard are in crystals of the same size and proportion as the corundophyllite, and occupy the same position in the fissures, coating the magnetite on either side and having a layer of diaspore between them. They agree with the corundophyllite in being optically positive, but with small angle. The axial angle varies from 20° to 28° in a single crystal of amesite and from 32° to 70° in one of corundophyllite. The crystals of amesite are often made up of three individuals, and in cleavage plates the axial planes of the three parts make angles of 60° with each other.

1891. **Amesite.** Chester.

In an elaborate article upon the chlorites Tschermak has taken amesite as the first member of a series which includes all the principal chlorites, and these are formed from it by adding an increasing number of serpentine atoms to the amesite atom, which is the richest in alumina. Thus corundophyllite is composed of one molecule of serpentine and four of amesite. This is abstracted fully in E. S. Dana's Manual of Min., p. 643.

G. Tschermak: Die Chloritgruppe. Sitzungsberichte d. Akad. Wien, XCIX, p. 212.

(The above would suggest that the amesite may have been derived from the corundophyllite by its splitting into four molecules of amesite and one of serpentine. I have found no serpentine which would seem to have had this origin associated with the amesite.)

AMPHIBOLE.

1818. **Hornblende.** Deerfield.

"Very abundant; mostly black in this vicinity."

E. Hitchcock: Geol. Deerfield, etc.; Am. Jour. Sci., 1st series, Vol. I, p. 113.

1820. **Actynolite.** Middlefield.

Often containing small tufts of the fibrous variety. Discovered by E. Emmons.

Professor Dewey: Am. Jour. Sci., 1st series, Vol. II, p. 236.

1822. **Actynolite.** Middlefield (Mr. Coleman). Cummington (Dr. J. Porter).

As beautiful as that of the Tyrolese Alps.

Editor's note, ibid., Vol. IV, p. 54.

1823. **Hornblende.**

Lamellar hornblende occurs in Holland (Eaton), Leverett, Sunderland, Conway, etc. Black hornblende in Shutesbury, green in sienitic granite and gneiss; at Leyden, in fine fibers; also in Shelburne, Conway, Goshen, etc., in mica-slate, in large or broad fibers (latter citation = zoisite).

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 226.

1823. **Fasciculite.** (Hitchcock.) Hawley, Plainfield, Conway.

This is composed of fibers, or rather in many instances of lamellæ, frequently more than one-tenth of an inch broad, diverging at both ends so as to occupy usually as many as 60° of a circle. These lamellæ are commonly inserted perpendicularly to the folia of the slate in which they are inserted, and are applied to each other by their broader faces being bent outward on both sides somewhat like a bow, and presenting elegant and very perfect fascicles. The fibers or lamellæ scarcely, if ever, cross one another, yet sometimes they diverge in nearly straight lines and sometimes are so much curved as to resemble very exactly a sheaf of wheat. Length, 1 to 4 inches. In mica-slate and talco-micaceous slate in Hawley, Plainfield, and Conway. I could not resist the temptation to denominate them fasciculites.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 226.

1823. **Hornblende, Actynolite.** Hawley (Eaton), Cummington (J. Porter), Belchertown, Shutesbury in gneiss, New Salem, acicular crystals in chlorite.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 227.

1823. **Tremolite.** Chesterfield, Cummington.

Asbestos with actynolite at Windsor, near the Cummington soapstone quarry.

J. Porter: Min. Loc.; Am. Jour. Sci., 1st series, Vol. VI, p. 248.

(This is called scapolite (ibid., Vol. VII, p. 253), but is probably zoisite.) Cummington; radiated, with quartz and beautiful garnets.

1823. **Hornblende.** Hawley. Plainfield, etc.

Describes the fasciculite of Hitchcock.

Ibid.

1824. **Tremolite.** Middlefield.

In large masses of aggregated flattened crystals with rhombspar (Emmons). These crystals often pass off into a perfectly granular tremolite.

C. Dewey: Geol. Berkshire; Am. Jour. Sci., 1st series, Vol. VIII, p. 46; Robinson's Cat., p. 60.

1824. **Cummingtonite.** (Dewey.) Cummington.

"I have here given this name to a mineral found by Dr. J. Porter in Cummington. It appears to be a variety of epidote. Its color is gray, sometimes with a faint reddish tinge, unless when acted on by the weather, when its color is yellowish. It is in distinct prisms, with oblique seams like zoisite, and in radiated or fascicled masses, which are composed of slender prisms. Luster somewhat shining or pearly. It is nearly as hard as quartz, and sometimes makes a slight impression upon rock crystal. Before the blowpipe it blackens, and a small portion melts, when the heat is very great, into a black slag, which is attracted by the magnet. With quartz and garnet it forms a large mass in Cummington."

C. Dewey: Geol. Min. Mass.; Am. Jour. Sci., 1st series, Vol. VIII, p. 59.

1824. **Cummingtonite.** Lies by the roadside in the east part of Cummington.

Known to the common people for several years under the name of copperas rock; occasionally used in dyeing as a substitute for sulphate of iron.

J. Porter: Min. Loc.; Am. Jour. Sci., 1st series, Vol. VIII, p. 233.

1824. **Hornblende**. Pelham.

Also actynolite in asbestos, Pelham, and likewise a granular variety of the same mineral in large masses—the grains equaling in size the grains of coarse gunpowder, and very easily separable. Its granular structure may be the result of semidisintegration.

C. W. Shepard: Min. Loc.; Am. Jour. Sci., 1st series, Vol. VIII, p. 235. Should be C. U. Shepard.

1825. **Fasciculite**. Charlemont (Dr. H. W. Wells).

Very fine.

J. Porter: Min. Loc.; Am. Jour. Sci., 1st series, Vol. IX, p. 54. Robinson's Cat., p. 40.

1825. **Cummingtonite**. Plainfield in considerable quantities.

It is perfectly well characterized, many of the specimens being elegant and even superb.

J. Porter: Min. Loc.; Am. Jour. Sci., 1st series, Vol. IX, p. 54.

1825. **Asbestus**. Zoar.

The ligniform variety abundant in serpentine on the banks of Deerfield River (H. M. Wells).

Robinson's Cat., p. 78.

1825. **Actynolite**. Westfield, occasionally; fine.

Emerson Davis: Min. Not.; Am. Jour. Sci., 1st series, Vol. IX, p. 252.

1825. **Cummingtonite (Fibrolite)**. Cummington.

E. Emmons: Boston Jour. Phil. and Arts, Vol. III, p. 395.

1825. **Fibrolite**. Chesterfield.

E. Hitchcock, ibid., p. 610.

1825. **Anthophyllite**. Zoar (Charlemont).

In serpentine resembles that found in Blandford.

C. U. Shepard: Boston Jour. Phil. and Arts, Vol. III, p. 309.

1825. **Anthophyllite**. Blandford.

"Mr. Alonzo Chapin has lately presented me with a mineral that he has discovered in considerable abundance in the town of Blandford, which I find to be very well characterized anthophyllite. In a green talcose rock having a slaty structure, with veins of blackish serpentine running through it; massive and in long acicular prisms, radiating, hair brown." Cleavage, 125°. Infusible.

C. U. Shepard: Min. Loc.; Am. Jour. Sci., 1st series, Vol. IX; also Boston Jour. Phil. and Arts, Vol. II, p. 395.

1827. **Cummingtonite**. Chesterfield, Goshen.

In mica-slate.

A. Nash: Lead Mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 260.

1827. **Amianthus**. Plainfield.

White, very fine and delicate.

J. Porter: Min. Loc.; ibid., p. 378.

1828. **Anthophyllite**. Blandford, 20 rods southeast of village; East Granville road; also 1 mile south on same road.

Hitchcock searched out the mineral at the above locality as the anthophyllite described by Shepard in the preceding citation. It fused, and so he sent specimens to Professor Shepard to see if they were the same as his. Professor Shepard writes that the mineral sent agrees in crystallographical characters and in its fusibility with a genuine specimen of anthophyllite from Norway, and says: "This led me to reexamine a mineral from

1828. **Anthophyllite**—Continued.

the same town which I recently described in the Boston Journal under the name of anthophyllite. I find myself to have been in error as to my examination of its crystalline form and some other characters. At present I regard this mineral as constituting a new species, of which I propose at a future day to give a particular account."

E. Hitchcock: Min. Ex.; Am. Jour. Sci., 1st series, Vol. XIV, p. 221.

(The mineral described above by Hitchcock is the coarse-bladed hornblende in the Osborne soapstone quarry, which is partly brown and associated with black serpentine. That first described by Professor Shepard, if infusible, may have been enstatite from farther south. The promised description of it as a new species apparently never appeared.)

1828. **Actynolite**. Center of Shutesbury opposite mineral spring.

E. Hitchcock: Min. Ex.; ibid., Vol. XIV, p. 217.

1828. **Anthophyllite**. Chesterfield, 1 mile north of meetinghouse on land of Mr. Searle, with kyanite and zoisite.

E. Hitchcock: Min. Not.; ibid., p. 216. (This is the brown fibrous hornblende associated with large garnets and called above cummingtonite.)

1835. **Anthophyllite**. Chesterfield, Blandford.

With quartz in mica-slate.

C. U. Shepard: Min., Vol. II, Part I, p. 27.

(The Chesterfield mineral was cummingtonite. The Blandford mineral was actynolite, cited in 1833, probably from Osborne soapstone quarry.)

1835. **Tremolite** in rhombspar. Middlefield; also ligniform and compact asbestos.

E. Hitchcock: Geol. Mass., p. 363.

1835. **Actynolite**. Middlefield, Blandford, Zoar.

E. Hitchcock: Loc. cit.

1835. **Fasciculite** in talcose slate. Plainfield.

E. Hitchcock: Loc. cit.

1835. **Anthophyllite**. Pelham, in gneiss.

E. Hitchcock: Geol. Mass., p. 399.

I can not feel sure what mineral was intended here; probably the black hornblende, which occurs rarely in the gneiss.

1835. **Anthophyllite**. Chesterfield, with sappare (cyanite) and garnet; Chester, with pyroxene, garnet, and staurotide; Blandford, abundant.

In fibrous masses or imperfect prisms embedded in the mica-slate.

E. Hitchcock: Geol. Mass., p. 347; also, Final Report, 1841, p. 606.

1835. **Cummingtonite** (= epidote. Dewey.) Cummington and neighboring towns. Warwick.

E. Hitchcock. Ibid.

1835. **Cummingtonite**. Plainfield. Cummington.

Hemiprismatic wavelline spar. Full description and analysis by Muir. Columnar, ash-gray; H 6.5, gr. 3.2014:

SiO_2	56.543
FeO	21.669
Mn	7.802
Na_2	8.439
H_2O	3.178

C. U. Shepard: Min., Vol. II, Part I, p. 159.

1841. **Cummingtonite.** Cummington. In mica-slate.

"Dr. Thompson is decidedly of opinion that this mineral belongs to a new species allied to the karpholite."

E. Hitchcock: Geol. Mass., p. 607.

1841. **Actynolite.** Middlefield, Zoar, Blandford.

In talcose slate. Finest from Blandford; in talcose slate, fine fibrous hornblende. Fasciculite.

Ibid., p. 613.

1841. **Hornblende.** Chester.

"Near the chromite-of-iron locality, in the west part of Chester, a mineral occurs in talcose slate in indistinct prisms of a black color, which I shall call hornblende; but I should not be surprised if a more careful examination than I have found time to make should prove it to be acmite, which comes to us from Norway only."

Ibid., p. 614.

(This is the black radiated tourmaline in hexagonal prisms from the North mine and along the whole eastern selvage of the emery vein, which closely resembles hornblende, and was described by Shepard as tourmaline.)

1841. **Tremolite.** Middlefield.

In bitter spar in serpentine. Ligniform and compact varieties are found in the same steatite bed; also at Zoar, in talcose slate.

E. Hitchcock: Geol. Mass., p. 613.

1841. **Actynolite.** Westfield, in serpentine.

"Also a mineral which I am disposed to refer to anthophyllite." (This is enstatite.)

Ibid., p. 618.

1844. **Cummingtonite.** (*Augitus scopiformis.*) Cummington and Plainfield.

J. D. Dana: Sys. Min., p. 373.

1844. **Hornblende.** Chester; with obtuse edges truncated.

F. Alger: Min., p. 83.

1876. **Anthophylline.** Chesterfield, Pelham.

C. U. Shepard: Cat. of Min., within 75 miles of Amherst College, p. 5.

1878. **Cummingtonite.**

Iron magnesia amphibole.

J. D. Dana: Min., p. 234.

1885. **Hornblende.** Chester.

A fibrous black hornblende from near Chester, Mass.; affords an imperfect cat's-eye.

G. F. Kunz: Precious stones; in Min. Res. of U. S., 1885, p. 728.

"Some time ago there were a number of pieces sold in New York as coming from Chester, Mass. It was a fibrous hornblende, in fiber almost as fine as crocidolite. I think someone called it Bentonite."

G. F. Kunz: Private communication, Feb. 5, 1886.

1885. **Actinolite.** North Blandford.

In large quantity; fine, acicular, deep-green, and in all stages of change to steatite, at Bartholomew's quarry, North Blandford, and in still larger and finer masses at Osborne's quarry, near the middle of the same town. In granular masses of the finest emerald-green at the Pelham asbestos mine.

1890. **Cummingtonite.** Chesterfield.

The hair-brown hornblende, so long called anthophyllite, occurs in a highly pyritous rock associated with large garnets, and can be best obtained in the bluffs west of Bunnells Pond, in Chesterfield, and from large bowlders down the hill nearly a mile southeast of Chesterfield church.

1891. **Actinolite.** Pelham.

The new excavations have afforded the richest-colored deep-green actinolite, in long, fibrous, sheaf-like, and radiating masses.

1891. **Hornblende** changed to a mixture of epidote and chlorite. Chester.

Very attractive specimens were furnished abundantly from the first cut west of the Chester station, flat black blades penetrating a white granular quartzite forming a bed in the hydro mica-schist. This hornblende is at times altered into a mixture of granular epidote surrounded by a superficial layer of blackish-green chlorite. (See Epidote.)

1891. **Fasciculite** changed to biotite.

The "fasciculite" or radiating hornblende of the Charlemont "fasciculite schists" is at times changed into a dark-brown to black biotite, arranged in a series of overlapping scales about as broad as the cross-section of the thin blades of the original mineral.

1891. **Crocidolite.** Chester.

A pale-green, rigidly columnar mineral, breaking in rods about 4 inches long, was distributed in exchange by Professor Shepard under this name. It is a granular calcite-asbestos mixture, only a few fibers being left behind in acid. Under the microscope narrow, wavy bands of serpentine are seen to run through the mass.

AMPHODELITE.

See Oligoclase.

ANALCITE.

1818. **Analcime.** Deerfield.

Very abundant, associated with quartz and amethyst, which are sometimes inclosed in analcime; generally cylindrical, reniform, radiated, a few perfect crystals. One mile from Deerfield Academy, E. 2° 15′ S.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1818. **Analcime.** Deerfield.

Occurrence in secondary greenstone.

Review of Cleaveland's Mineralogy, by E. Hitchcock; Am. Jour. Sci., 1st series, Vol. I, p. 49.

1823. **Analcime.** Deerfield.

Usually in laminated or radiated masses which are reniform, cylindrical, or nearly spherical; very rarely in trapezoidal crystals; color white, gray, and flesh color. Associated with calcareous spar, quartz, chalcedony, etc., and frequently effervesces a little with acid.

E. Hitchcock: Geol. Conn.; ibid., Vol. VI, p. 224.

1835. **Analcime.**

Occurrence doubtful.

E. Hitchcock: Geol. Mass., small ed., p. 436.

1841. **Analcime.** Chester, in mica slate (Emmons).

E. Hitchcock: Geol. Mass., p. 606.

(It occurred in beautiful amber-colored crystals on fissures in hydromica-schist. There were fine specimens in the Shepard collection. I have not been able to recover the locality.)

1841. **Analcime.**

"Has been frequently said to be quite common, but I am suspicions that calcareous spar has been confounded with that mineral, and I dare not say that it exists in our greenstone."

E. Hitchcock: Geol. Mass., p. 662.

1876. **Analcite.** Chester.

C. U. Shepard: Cat. of Min., within 75 miles of Amherst College, p. 4.

1882. **Analcite.** Deerfield.

Occurred (*a*) in a single crystal upon prehnite; (*b*) in flat 8-sided plates. 10 to 12 mm. across, striated and formed by the growth of the trapezohedron in a narrow fissure; (*c*) in milk-white films circular and octagonal, 5 to 10 mm. across; (*d*) in extremely fine botryoidal surfaces with crystalline structure, with here and there a system of curious concentric depressed rings, like the siliceous annulations on some fossils (beckite). They are as if formed by pressing several rings, each smaller than the other, into a soft mass, so that it should rise as a series of thin concentric combs between them; (*e*) other pieces which seem to me to have been analcite of the form (*b*) are now wholly decomposed into a yellow ferruginous kaolin (?).

Associated with the analcite (*b*) and resting against the separate crystals on all sides is opaque white calcite $\frac{1}{4}$ R and 1^5, grouped in parallel clusters, the faces all rounded and the clusters looking as if they had been made of some soft material which had "run." This grouping of the calcite around the separate crystals of the analcite may explain the annulations mentioned above, the two minerals having increased alternately and the calcite afterwards having been removed.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 201

ANDALUSITE.

1885. **Chiastolite.** Whately, Mass.

The Whately argillite is changed on contact with the Hatfield tonalite (sienite) to a "garben schiefer" full of slender chiastolites above an inch long, but altered now to a mixture of muscovite and minute and perfect staurolite crystals. The chiastolite pseudomorphs still retain the black cross of coaly particles.

1890. **Chiastolite.**

For supposed chiastolites in the Trias, see Salt.

1893. **Chiastolite.**

"Crystals from Springfield" cited from Dana. (Sys. Min., 6th ed., 1892, p. 497.)

F. Becke: Tschermak Min. Mit., Vol. XIII, p. 257.

(The crystal is a common Lancaster crystal, which is said by Dana to have been "dissected by B. Horsford, of Springfield.")

ANDESITE.

1876. **Andesite.** Pelham.

Closely associated with a shining red-brown biotite in loosely aggregated scales. The andesite is in large highly crystalline individuals, and is intimately associated with similar individuals of corundumite, though the latter are of infrequent occurrence. (SiO_2, 57.20; CaO, 8.7.)

C. U. Shepard: Contributions to Min. (private publication), p. 4.

1883. **Andesite.** Pelham asbestos mine.

Sections cut from the specimen analyzed by Professor Shepard parallel to the axes gave extinction —4-5° on $0\,P$ and —13-14° on $\infty\,P\,\breve{\infty}$, which agrees with andesite, or a form between andesite and labradorite. The compact specimens named by him andesite are mostly anorthite, and are distinguished from those named anorthite by him only in the presence of disseminated biotite. It is all well advanced in decomposition, being much dusted with muscovite. It contains zircon. Nearest the tourmaline the mass is finest grained, white, free from biotite, and nearly all anorthite; farther away the grain gets coarser and the andesite increases gradually. Its twinning bands are broad, equally thick, and continuous. Other egg-shaped masses in the massive biotite, but farthest from the central mass, were very fresh and limpid and often gave conchoidal fracture. They gave an extinction on P of —1.30, and were thus intermediate between andesite and oligoclase—an interesting gradation from the basic anorthite near the olivine to the oligoclase near the acid gneiss.

ANGLESITE.

1811. **Sulphate of lead.** Loudville.

In plates or tables on cubes of galena and in cavities in quartz.

William Meade: Bruce's Am. Min. Jour., Vol. I, p. 150.

1811. **Muriate or carbono-muriate of lead.** Loudville.

With description; very light green; groups of a cubic form terminated by tetrahedral pyramids; slightly affected by nitric acid.

William Meade: Bruce's Jour., Vol. I, p. 151.

1823. **Carbonated muriate of lead.** Loudville.

Same, above quoted.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 234.

1823. **Sulphate of lead.** Loudville.

Meade's description (1811) quoted.

E. Hitchcock: Geol. of Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 234.

1835. **Sulphate of lead.** Loudville.

Small plates on galena.

E. Hitchcock: Geol. Mass., p. 508.

1835. **Murio-carbonate of lead.** Loudville.

Same, above quoted.

E. Hitchcock: Geol. Mass., p. 507.

1835. **Corneous lead.**

C. U. Shepard: Min., Vol. I, Part II, p. 149.

Not mentioned in third edition.

1841. **Murio-carbonate of lead.** Loudville.

Previous account repeated.

E. Hitchcock: Geol. Mass., p. 705.

1841. **Sulphate of lead.** Loudville.

In small plates on galena.

Ibid., p. 705.

1865. **Phosgenite.** Southampton. Loudville.

Suggests that the stolzite here described by him under the name scheeletine may have been mistaken for cerasite (phosgenite or mendipite) or matlockite, one or the other of which, under the old name of muriate of lead, has been supposed to exist at this locality.

C. U. Shepard: On scheeletine; Am. Jour. Sci., 2d series, Vol. XLI, p. 215.

The above suggestion can not be accepted, because stolzite is decomposed by nitric acid. The original mineral described by Meade can not have been phosgenite, which dissolves with effervescence in dilute nitric acid. Almost all the points given in the description of Meade agree with anglesite. The crystals of anglesite found here are often superficially green from copper. It is described further as vitreous, nearly the luster of a precious stone, glassy fracture, brittle, melts to orange mass with lead globules, formed on galena, and but slightly acted upon by nitric acid. All these points agree with anglesite, and only the crystalline form remains; "in cubic form terminated by tetrahedral prisms." It will be noted further that no one has ever found the mineral since Meade's description, but all have copied him. I found in 1885 (in the Clark collection of Smith College, which has the finest series of crystals from the Loudville mine) specimens which agreed also in cystallization. They are an exceptional form of anglesite and appear in grouped prismatic aggregates up to 10 mm. in length, surmounted by acute pyramids, and resembling acicular aragonite. At times the aggregated prisms are finely striate longitudinally, changing the resinous luster to satiny. It is translucent, colorless to slightly amber.

A fragment of a crystal treated with HNO_3 was only slightly affected. Before the blowpipe it turns yellow, decrepitates, and with soda gives lead globules and test for sulphur.

1866. **Cotunnite.** Southampton lead mine.

Found in four specimens by Mr. P. W. Lyman; small groups lining quartz; right rhombic prisms, milk-white, opaque, soluble.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 247.

1885. **Anglesite.**

All the specimens upon which the above determination was made have passed through my hands, and are anglesite of very simple crystalline form. The best specimen—a large mass of quartz with many crystals—was burned with the Shepard collection. The second best piece has since been presented to the college by the finder, Rev. P. W. Lyman. Several other specimens are in the J. Clark collection of Smith College.

The following observations were made by me on the specimens presented by Rev. P. W. Lyman and determined by Professor Shepard, and also on others labeled by Mr. J. Clark as determined by Professor Shepard: Crystals in right rhombic prisms ∞P, $0 P$—largest, 1¼ mm. long, ¼ mm. wide—scattered over the surface of quartz in cavities in quartz or cerussite; color snow-white, opaque. In a single instance the face of another prism appears about $\infty P \breve{2}$; base striated parallel to long diagonal; prisms horizontally striated; broken crystals show the interior to be translucent and of resinous luster; prism faces slightly barreled and composite, the larger

1885. **Anglesite**—Continued.

crystals at times grouped and radiating like stilbite; small crystals transparent at the ends; average of many varying measurements, I ∧ I, 76° 30′ (anglesite = 76° 16½′).

No trace of solubility could be detected. Chlorine and lead were tested for in vain in the water in which the crystal had been boiled; as also in the nitric-acid solution. Before the blowpipe it turns yellow, decrepitates; with soda gives globules of lead and strong test for sulphur.

ANKERITE.

1825. **Carbonate of iron.** Cummington.

At rhodonite locality; laminated masses; not large.

E. Hitchcock: Loc. Min.; Am. Jour. Sci., 1st series, Vol. IX, p. 22.

1825. **Carbonate of iron.** Plainfield.

Beautiful crystals; rhombs nearly white, curved faces.

J. Porter: Ibid., Vol. IX, p. 54.

1827. **Carbonate of iron.** Charlemont, Hawley, Chester.

J. Porter: Min. Not.; ibid., Vol. XII, p. 378.

1835. **Ankerite.** West Springfield.

See Dolomite.

1841. **Carbonate of iron.** Cummington.

In bowlders of manganese ore.

E. Hitchcock: Geol. Mass.; Final Rept., p. 613.

1892. **Ankerite.** Hawley, Charlemont.

The following analyses represent the composition of the carbonate so abundantly disseminated in the Hawley schists.

No. 1, by L. G. Eakins, of the United States Geological Survey, is from a chlorite-schist in which the coarsely granular carbonate is disseminated like the feldspar in a gneiss. It is from a point just south of the road running over Forge Hill, in Hawley, near the first mine in the pasture of M. V. Cressy.

No. 2, also by Mr. L. G. Eakins, is from quite large rhombohedra of the same mineral in chlorite-schist from the hill a mile north of the hotel in Charlemont.

No. 3 is by Mr. C. L. Upton, class of '91, in Amherst College, and is the mean of two analyses. It is from the fine large rhombohedra found in chlorite-schist in Hawley, in the gorge near the mill, opposite the town hall.

	No. 1.*	No. 2.	No. 3.
SOi_2	3.87	.67	†3.77
Al_2O_3	2.72	Trace.	CaO MgO †0.98
Fe_2O_3	1.75	.08	†1.23
FeO	1.34	7.60	7.40
MnO	.05	1.61	....
CaO	3.34	28.63	27.62
MgO	4.50	16.17	15.87
K_2O	.19	(NiO .03)	....
Na_2O	.15	....	....
CO_2	4.51	‡45.35	‡43.13
	22.82	100.14	100.00

* Soluble in HCl. † Gangue. ‡ Loss.

This gives for No. 2 the formula $CaCO_3+FeCO_3+2\frac{1}{5}(CaMgC_2O_6)$.

ANHYDRITE.

1892. **Anhydrite.** Northampton.

Larrabee's quarry, beside the Connecticut River, on the north line of Holyoke. A very exceptional and interesting occurrence of anhydrite has just come to my knowledge. Its geological significance will be discussed in the monograph on the geology of the area. Within a small space, a foot or two beneath the surface of the trap mass exposed in the quarry, the large irregular cavities in the trap, 1 to 2 inches thick and 3 or 4 inches in the other dimensions, are filled (instead of with calcite, as is usual) with the finest bluish anhydrite. It is in tabular masses, precisely like the Chesterfield cleavelandite.

The tabular aggregates are generally slightly radiated, and the plates reach 2 or 3 inches in length. They at times radiate so rapidly in smaller plates that the latter curve 90° in a single inch. The plates vary in width from an eighth of an inch down to extreme fineness, are bounded by nearly parallel planes, but taper slowly to an edge, and are replaced by the thickening of their neighbors. The planes bounding these plates are parallel to $\infty P \breve{\infty}$ (010). As a result of this structure a mass broken across the face of perfect cleavage $0 P$ (001) closely resembles in luster and habit the striated prism faces of apophyllite, the cleavage is so exceptionally perfect. It resembles even more closely the triclinic striation of albite when the latter structure is coarsely developed. Sections including several plates cut parallel to $0 P$ polarize as units and show the obtuse bisectrix.

Sections parallel to $\infty \bar{P} \infty$ (100) show the same partings and give the axial figure in the same position on all the bands; so there is no twinning.

Sections parallel to $\infty P \breve{\infty}$ (010) do not extinguish entirely. They show a decided cleavage parallel to $P \bar{\infty}$ (101), along which the mineral often separates readily.

One cavity showed traces of fibrous, finely striated crystals.

The surface of the outflowing trap sheet was covered with mud while still plastic, and trap and shale are confusedly mingled. There is much pyrite in the trap and much secondary calcite in the cavities, often with the anhydrite.

ANORTHITE.

1876. **Anorthite.** Pelham.

"Found abundantly at the asbestite mine of Pelham. Massive, granular to compact; color grayish, yellowish, or pinkish white. It is the indianite variety of the species and contains 19.4 of CaO."

C. U. Shepard: Contrib. to Min. (priv. pub.), p. 4, and Cat. of Min. within 75 miles of Amherst College, p. 5.

1876. **Anorthite.** Pelham.

The following analysis was made by Mr. Josiah Keep, of the class of '74, Amherst College: The material was taken from the opaque white, fine granular variety nearest the olivine rock. The specimen was one labeled anorthite by Professor Shepard:

SiO_2	48.87
Al_2O_3 (dif)	36.76
CaO	10.82
K_2O	1.35
Na_2O	2.20
	100.00

1882. **Anorthite.** Pelham. Asbestos mine.

Some well-formed small crystals occur implanted in tourmaline—albite twins with few faces.

1883. **Anorthite.** Pelham. Asbestos quarry.

The fine white compact mass nearest the tourmaline (Shepard's type) gives extinction in twin laminæ 25° to 38°, and so is probably anorthite. The crystals are almost simple, with very minute interspersed laminæ in two directions at right angles. It is much decomposed into muscovite, and carries zircon, and is mixed with andesite.

1892. **Anorthite.**

The feathery porphyritic groups of first consolidation in the diabase uniformly show the optical characters of anorthite.

ANTHRACITE.

1835. **Anthracite.** Turners Falls, in Gill; at the Southampton lead mine, in Triassic sandstone.

E. Hitchcock: Geol. Mass., p. 227.

1841. **Anthracite.** Above repeated.

E. Hitchcock: Geol. Mass., Final Rep., p. 137.

ANTHOPHYLLITE.

1818. **Asbestus.** Pelham.

Compact.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1823. **Asbestus.** Pelham.

With serpentine and talc.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 225.

1824. **Compact asbestus.** Pelham.

C. U. Shepard: Min. Loc.; ibid., Vol. VIII, p. 235.

1870. **Asbestus.** Pelham.

Land of Mr. Samuel Newell; recent excavations for economical purposes prove it inexhaustible.

J. H. Adams, class of '70, Amherst College: Am. Jour. Sci., 2d series, Vol. XLIX, p. 271.

1876. **Asbestite.** (Shepard.) Pelham.

Fibrous and hard; sp. gr., 2.9 to 3.

SiO_2	59.40
MgO	30.60
FeO	7.60
H_2O	1.56
Al_2O_3CuO	Trace.
	99.6

Compact and subslaty; sp. gr., 2.93.

SiO_2	58.91
MgO	29.37
FeO	9.37
HO	3.37
Al and Ca	Trace.
	100.92

C. U. Shepard: Min. Cont. (priv. pub.), p. 3.

1876. **Asbestite.** Pelham.

C. U. Shepard: Cat. Min., 75 miles of Amherst College, p. 3.

1877. **Asbestoid bronzite.**

After quoting the two analyses of "asbestite," given above, Shepard says, "They are both undoubted varieties of bronzite. The fibrous variety exactly resembles this species from Aloystha (Aloysthal), in Moravia, except in wanting the dark color and bronzy luster of the Moravian mineral and in having, through partial decomposition, a somewhat lower hardness. The peculiar oblique cross cleavage of the fibers from both localities is very strikingly similar. The common, coarsely granular bronze variety is also found in small quantity at Pelham, diffused through rounded masses of considerable dimensions of the peculiar mineral named by me Pelhamine. These masses are enfolded in the closely contiguous biotitic schist.

C. U. Shepard: Contrib. to Min., p. 4; Amherst, May 11, 1877.

1893. **Anthophyllite.** Pelham.

In the geological monograph the "asbestus" of the Pelham asbestos mine is discussed and its derivation from olivine established. This fibrous asbestiform mineral is a secondary one, being derived from the olivine rock and growing out from fissures which form a great network in the latter, in fibrous masses set transversely to these fissures which remain as central sutures to the new growth, so that the whole repeats on a large scale the microscopic decomposition of olivine. On the other hand, the bronzy mineral mentioned above by Professor Shepard is a true bronzite—an original constituent of the olivine-enstatite rock.

The fibrous mineral was proved to be anthophyllite by its uniform longitudinal extinction and by finding larger blades, measuring 54° 30′ to 55°.

1894. **Asbestus.** Pelham.

C. Hinze, p. 1231.

ANTIMONITE.

1822. **Sulphuret antimony.** Near South Hadley.

Cleaveland's Min., Vol. II, p. 688.

This occurrence has not been verified.

APATITE.

1824. **Phosphate of lime.** Chester.

In an aggregate of gray epidote, zoisite, hornblende, and quartz. Dissolves slowly in NO_5. Whitish-yellow. Fragments transparent. Form a rectangular prism.

E. Emmons: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 254.

1824. **Phosphate of lime.** Chester.

Disseminated in granite. Also the variety apatite in yellowish-green crystals and granular masses phosphoresces on hot iron with pale-yellow light; also in mica-slate in roundish masses. Its powder digested in H_2O changes vegetable blue to green (Emmons).

C. Dewey: Geol. Berkshire Co.; ibid., Vol. VIII, p. 36.

1825. **Phosphate of lime.** Williamsburg.

"July, 1824. This mineral was forwarded to me in June last by Morris Dwight, its discoverer. It is embedded in a rock of gneiss. * * * Color delicate straw yellow, pale green, greenish white, apple green. Large 6-sided prisms more than 1 inch in length terminate by flat plane."

B. Silliman: Notice of a mineral supposed to be phosphate of lime from west Massachusetts; Am. Jour. Sci., 1st series, Vol. IX, p. 174.

Google

1827. **Asparagus stone.** Williamsburg, in granite.

Prisms several inches long; and another variety of phosphate of lime in mica-slate in grains.

A. Nash: Lead mines of Hampshire County; ibid., Vol. XII, p. 260.

1835. **Apatite.** Williamsburg, Chesterfield, Chester, Middlefield, Norwich, Conway.

In Williamsburg, hexagonal, delicately green crystals; in Norwich, in gray quartz and black mica near granite. One crystal 6 inches long by 3 inches across.

E. Hitchcock: Geol. Mass., p. 343.

1841. **Apatite.** Williamsburg, Chesterfield, Chester, Middlefield, Norwich.

Williamsburg, hexagonal, delicately green; Chesterfield, with kyanite. Resembles chrysoberyl in appearance. Norwich, in gray quartz, with black mica, near granite. One imperfect crystal (No. 728, State collection) 3 inches in diameter, 6 inches long.

E. Hitchcock: Geol. Mass., p. 604.

1844. **Apatite.** (*Fluellus hexagonus.*) Norwich, Chester, Chesterfield, and Williamsburg.

J. D. Dana: Sys. Min., p. 238.

1876. **Apatite.** Pelham, Huntington.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 2.

1879. **Apatite.** Walnut Hill, Huntington.

In tourmaline granite veins.

A. A. Julien: Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 352.

1883. **Apatite.** Pelham asbestos quarry.

An exquisite 6-sided prism one-half inch long, green at ends and down middle apparently, but satiny white on faces, and with plumose surface. Given me by Mr. Thompson for mineral collection of Amherst College.

1885. **Apatite.** Rowe.

Small light-green crystals in pyrites at the mine of J. M. Davis & Co.

A. G. Dana: Gahnite at Rowe; Am. Jour. Sci., 3d series, Vol. XXIX, p. 455.

1891. **Apatite.** Pelham.

The new working of the asbestos mine has furnished many beautiful crystals. They are embedded in the biotite fringe rock, with nodules of hornblende and corundum, and in the massive tourmaline. They are transparent, rich oil-green. The form is a short, stout prism with flat ends. The largest was 3 inches long and 2 wide, showing the faces ∞P, $0 P$. P, $\infty P 2$. Some are weathered through and through to opaque white, like the Snarum crystals.

1895. **Apatite.** Chester.

Occurs in small, pale-green crystals with corundophyllite, in the Chester emery vein.

ARAGONITE.

1825. **Aragonite.** Middlefield.

Yellow, transparent. H. = 4; sp. gr., 2.39. Dissolved in nitric acid with effervescence. Exactly resembled the Bilin crystals, with rhombspar in steatite, found by Dr. Emmons.

C. U. Shepard: Bost. Jour. Phil., Vol. III, p. 609. (The sp. gr. changed to 3.93 in Professor Shepard's copy of the Journal.)

1887. **Aragonite.** Chester emery mine.

Beautiful crystals, of the usual acicular type and 20 mm. long, occur coating fissures; also in radiated tufts; the best specimens in the cabinet of the late Mr. Ames, of Chicopee.

ARSENOPYRITE.

1823. **Mispickel** (arsenical iron?). Gill.

Bowlder of several pounds. Dr. Alpheus Stone.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 232.

1876. **Arsenopyrite.** Bernardston.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 8.

[Probably exists only in bowlders.]

ASBESTOS.

See Anthophyllite and Amphibole.

ASTROPHYLLITE.

1866. **Astrophyllite.** Northfield.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

See Biotite.

AUTUNITE.

1835. **Uranite.** Chesterfield, Mass.

At tourmaline vein. Crystalline plates and pulverulent. Emerald green (Mr. Shepard).

Ed. note: Am. Jour. Sci., 1st series, Vol. XXVIII, p. 382.

1841. **Uranite.** Chesterfield.

Found by Professor Shepard in small quantity.

E. Hitchcock: Geol. Mass., p. 704.

1841. **Uranite.** Chesterfield.

J. E. Teschemacher: Proc. Bost. Soc. Nat. Hist., Vol. I, p. 15 (abstract); Bost. Jour. Nat. Hist., Vol. IV, p. 35.

1844. **Uranite.** (*Uranalus quadratus*). Chesterfield.

Discovered by Teschemacher in centers of red tourmalines.

J. D. Dana: Min., 2d ed., p. 297.

1845. **Uranite.** Chesterfield.

Prof. C. U. Shepard claims priority over Teschemacher of discovery of uranium at Chesterfield.

Am. Jour. Sci., 1st series, Vol. XLVIII, p. 179.

1845. **Uranite.** Chesterfield.

Maintains claim to priority of discovery of uranite on ground that the publication of the Proceedings of the Boston Society of Natural History was April, 1841; that of Professor Hitchcock's Geology of Massachusetts, to which Shepard refers, was in November, 1841.

J. H. Teschemacher: Am. Jour. Sci., 1st series, Vol. XLVIII, p. 395.

1868. **Autunite.** Chesterfield.

In minute crystals on the quartz or albite, and sometimes in the red centers of tourmalines.

J. D. Dana: Min., p. 587.

1879. **Autunite**. West Chesterfield.

On cleavage planes of spodumene, derived from alteration of zircon containing uranium.

A. A. Julien: Spodumene and its alterations; Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 354.

AXINITE.

1819. **Augite**. Deerfield.

"In an aggregate of greenstone, quartz, and calcareous spar in the greenstone range of Deerfield. Color black, and the crystals usually imperfect or broken."

E. Hitchcock: Supp. Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. II, p. 436.

1823. **Augite**. Deerfield.

In irregular veins or imperfect crystals.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 225.

1835. **Augite**. Deerfield.

"Is of an iron-black color and in imperfect crystals or in veins; is sometimes met with in the tufaceous greenstone of the Connecticut Valley, as at a spot 1 mile east of the village of Deerfield."

E. Hitchcock: Geol. Mass., p. 435.

1841. **Augite**. Deerfield.

Same as 1835.

E. Hitchcock: Final Report on Geol. Mass., p. 661.

1882. **Axinite**. Deerfield; cut on canal railroad. South of the Deerfield River, at Cheapside.

Jet-black opaque crystals, the largest 10 to 12 mm. in length, embedded in prehnite, and calcite resting on prehnite. The crystals are thick plates, resembling, as do many of the minerals found here, the simpler forms from Bourg d'Oisins—the faces $'P\infty$ $(1\bar{1}0)$, and $P'\infty$ (110), large and striated vertically, and $'P\infty$ striated horizontally parallel to the intersection edge of $P\infty$ and $'P$ $(1\bar{1}1)$. The face $'P$ is smaller and striated horizontally. Rarely the faces $\infty P\breve{\infty}$ (010), $\infty P\bar{\infty}$ (100), and $2P\bar{\infty}$ (201) appear. Two very distinct distant cleavages, especially clear under the microscope, parallel to the two striations upon $'P$, and nearly at right angles to this face, thus nearly cubical. Thin splinters show brilliant trichroism, deep bottle-green, plum-blue, and clove-brown, and are glassy and easily transparent under the microscope, and entirely free from all impurities. The mineral has occurred also at the old locality east of Deerfield village, and appears in the State collection, Nos. 86, 87, labeled "Black augite in greenstone, Deerfield." I found also opposite Turners Falls a single perfect crystal 4 mm. long, black, with shade of brown, resting upon a botryoidal layer of diabantite in an amygdule. Some of the finest crystals of axinite occur in the datolite. The crystals are here sometimes short, stout prisms.

B. K. Emerson: The Deerfield Dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 350.

AZURITE.

1881. **Azurite**. Leverett.

With malachite in small portions, at new opening of upper Leverett mine.

1887. **Azurite**. Southampton lead mine.

Occurs surrounding chalcopyrite and intermixed with massive black copper oxide, also in thick coatings on quartz. Rare. Specimens in Clark collection of Smith College.

1890. **Azurite.** Chester.

In hornblende-schist at the main shaft of the emery mine.

BABINGTONITE.

1892. **Babingtonite.** Buckland.

Coating vertical north-and-south fissures in Cambrian gneiss at quarry beside railroad, near Shelburne Falls.

Broad surfaces are covered with a jet-black granular layer, which at times shows crystal faces. Dissolving away a layer of calcite, small crystals were exposed, with strongly striated faces of high luster, and having entirely the habit of babingtonite. The minuteness of the crystals and the striation prevented accurate measurement, but the following numbers were obtained:

	Found.	*Calc.*
c∧d	56°	57° 36′
c∧M	87° 10′	87° 28′
c∧m	67° 20′	67° 48′
c∧g	47° 20′	47° 36′

c = (001) 0 P d = $(2\bar{2}1)$ 2 ′P.
M = $(1\bar{1}0)$ ∞ ′P m = (110) ∞ P′.
g = $\bar{1}\bar{1}1$ P.

c, g, and m are striated parallel to their intersection; d and M the same.

The following analysis was made in the laboratory of the Survey by Mr. E. A. Schneider. The material was in part brownish from the beginning of decomposition, which explains the large per cent of water:

SiO_2	52.48
TiO_2	Trace.
Al_2O_3	1.93
Fe_2O_3	[1] 23.24
FeO	([2])
MnO	.37
MgO	1.55
CaO	19.31
K_2O	([3])
Na_2O	([3])
H_2O (105°)	.11
H_2O (above 105°)	1.03
P_2O_5	([3])
B_2O_3	([4])
	100.02

The mineral is intergrown with fine, small crystals of epidote, natrolite, chabazite, and quartz. The development of the faces is such that the crystals resemble axinite. On discussing the analysis Prof. F. W. Clarke pronounced the mineral babingtonite.

BARITE.

1810. **Barite.** From Southampton lead mine.

B. Silliman: Bruce's Min. Mag., Vol. I, p. 64.

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[1] Includes FeO.

[2] Not determined, owing to lack of material.

[3] Not determined.

[4] Spectroscop. good reaction.

1818. **Barite.** Greenfield.

Bank of Connecticut River; walls of copper vein, 1 inch to 1 foot on wall; vein, 6 to 8 feet.

E. Hitchcock: Geol. Deerfield, etc.; Am. Jour. Sci., 1st series, Vol. II, p. 115.

1822. **Barite.** Hatfield, Mass.

Sp. Gr., 4.28.

BaO	58.50
SO_3	29.83
SiO_2	4.00
Al_2O_3	2.00
H_2O	3.00
	97.33

Dr. Gorham: Cleaveland's Min., Vol. I, p. 137.

1823. **Barite.** Hatfield (Gorham), Middlefield (Eaton). Southampton, Leverett, Greenfield copper vein—in all lamellar.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 211.

1827. **Barite.** Leverett.

Vein in granite 1 mile northwest of meetinghouse on land of Mr. Field; 1¼ miles south on an eminence of granite; Hatfield, one-half mile west of town, vein in sienite; Williamsburg, east part; Whately.

A. Nash: Lead mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 249.

1832. **Barite.**

"I have been in the habit for several years of having various articles in the laboratory covered with it, and it answers a good purpose. Mixed with boiled linseed oil and lampblack, it is superior to anything I have found for labeling glass bottles in the laboratory."

E. Hitchcock: Geol. Mass.; Am. Jour. Sci., 1st series, Vol. XXII, p. 48.

1841. **Baryta.** Southampton, Leverett.

Abundant in granite, in veins.

E. Hitchcock: Geol. Mass., p. 700.

1885. **Barite.**

Other localities of barite are many small veins in granite in field north of South Leverett lead mine, and at the railroad cutting south of the crossing east of the same mine.

1885. **Crystallized quartz.** Quartz pseudomorph after barite. Norwich (Huntington).

The specimens labeled crystallized quartz, XIX 204–209, in the State geological collection now at Amherst College, from Angel's mine, are pseudomorphs in plates 1 to 3 inches square.

1885. **Barite.** Titan's Piazza, Mount Holyoke.

Members of the class of '85 of Amherst College found quartz pseudomorphs after barite in much fissured amygdaloidal rock from the upper portion of the great diabase sheet, in masses fallen from the cliffs above Titan's Piazza. The barite had coated the fissures on both surfaces with a drusy layer about 3 mm. thick, made up of tabular crystals 1.5 mm. across. The cavity was then filled with slightly amethystine radiating quartz, and later the barite was itself replaced by quartz. The crystals are tabular $0P$ (001), $P\breve{\infty}$ (101), $P\bar{\infty}$ (011). The rough faces gave only approximate measurements: $0P \wedge P\breve{\infty}$ 51°–53°, calculated 52° 43′; $0P \wedge P\bar{\infty}$ 57°, calculated 58° 10′.

1886. **Barite.** Northampton.

At granite quarry, south of W. N. Moore's, east of Florence, (1) in broad, large, and extremely thin crystals; pseudomorphs of quartz after barite; (2) in thicker incrustation pseudomorphs, also quartz after barite; and (3) compact barite, filling fissures 10 to 20 mm. wide.

1878. **Barite.** Florence, Northampton.

In veins in granite at the bridge and dam south of the brush factory.

1892. **Barite.** Northampton.

Larrabee's quarry in diabase on the Connecticut River Railroad above Holyoke.

The calcite filling fissures contains cavities from which thin tabular crystals of barite an inch square have been removed.

BASTITE.

1821. **Talc.** Russell.

A dark-colored serpentine containing scales of talc. Specimen sent by Dr. William Atwater.

Am. Jour. Sci., 1st series, Vol. III, p. 238.

1824. **Metalloidal diallage** (?). Middlefield.

In serpentine.

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 49.

1825. **Schiller spar.** Blandford.

In serpentine, associated with anthophyllite. Shining folia olive to black. (The anthophyllite is enstatite.)

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 608.

1832. **Green talc.** Russell.

E. Hitchcock: Geol. Mass.; ibid., Vol. XXII, p. 30.

1832. **Kerolite.** Blandford.

A leek-green and blackish-green variety in curved and stellular laminæ engaged in schiller spar.

SiO_2	40.0
MgO	41.4
CaO	0.932
FeO	2.70
H_2O	15.67
	100.702

C. U. Shepard: Min., Vol. I, Part II, p. 292.

1835. **Schiller spar** (?). Blandford.

Bowlders in the eastern part of Blandford, of a peculiar green serpentine, contain talc and schiller spar.

E. Hitchcock: Geol. Mass., p. 369.

1835. **Schiller spar.** Blandford.

C. U. Shepard: Min., Vol. II, Part II, p. 177.

1841. **Schiller spar.**

"The dark-green schiller spar found in serpentine in Blandford, Westfield, Russell, occurs in foliated masses."

E. Hitchcock: Geol. Mass., p. 618.

1841. **Schiller spar.**

The serpentine, as well as the schiller spar, is almost black, while the talc is green and somewhat brittle. Occurs only in Blandford, Russell, and Westfield.

Ibid., 1841, p. 615.

1844. **Schiller spar.** Blandford and Westfield.

F. Alger: Phillips, Min., p. 95.

1852. **Marmolite.** Blandford.

Dark-green variety.

C. U. Shepard: Min., Vol. I, Part II, p. 292.

1871. **Bastite.** Russell.

Optical axial angle 30°.

G. Tschermak: Ueber Pyroxene und Amphibole; Tschermak's mineral. Mittheil., Vol. I, p. 20 (4).

1876. **Serpentine.** Variety, marmoline. Russell, Blandford.

[Schiller spar not mentioned.]

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 3.

1876. **Phaestine.** Pelham.

On labels by Professor Shepard in Shepard collection, Amherst College. It is altered bronzite in black chrysolite rock from the asbestos mine.

1885. **Bastite.** Russell.

The blackish portions of the Russell serpentine from Atwater's quarry are in part still enstatite, in part are optically bastite, colored black by magnetite, and the latter portions do not differ from the leek-green plates first called marmolite by Shepard, except in the presence of disseminated magnetite in the former and its absence in the latter.

BERYL.

1813. **Emerald.** Chesterfield.

Dr. J. F. Waterhouse says crystals in hexagonal prisms, from an ounce and under up to 6 pounds, are found in granite. They occur up to a foot in diameter; color, light-green. He got 70 pounds.

Dr. Bruce: Bruce's Jour., Vol. 1, p. 264.

1813. **Emerald.** Vicinity of Northampton and Goshen.

"Found by that indefatigable mineralogist, Dr. David Hunt."

Ibid.

1819. **Emerald.** Chesterfield.

Crystals 3 to 5 inches long and 3½ inches in diameter; summit, a plane without additional facets, is perfect.

Col. G. Gibbs: On tourmalines, etc., at Chesterfield; Am. Jour. Sci., 1st series, Vol. I, p. 348.

1819. **Emerald.** Goshen.

Beautiful pale-rose, rather more transparent than the emerald.

Ibid., p. 351.

(This is the first mention of the "goshenite.")

1822. **Beryl.** Chesterfield.

Up to 1 foot in diameter, usually light-green (Bruce's Min. Jour.) Goshen. Two rose-colored emeralds are now in the cabinet of Colonel Gibbs; perfect crystals 1 to 1½ inches in length, 1 to 1½ inches in diameter, one truncated on lateral edges. (Gibbs.)

Cleaveland: Min., p. 344.

1823. **Beryl.** Chesterfield and Goshen (Gibbs).

At Chesterfield the crystals are sometimes from 9 to 12 inches in diameter. At Goshen some are rose-colored.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI. p. 222.

1824. **Beryl.** Near Goshen Center.

Found with white augite on north road from Goshen Center, more than 1 inch in diameter.

Ibid., Vol. VII, p. 30.

(The "white augite" is spodumene.)

1824. **Beryl.** Norwich, Chester.

One-half mile west from Pitchers Bridge, Norwich (now Huntington), near mass of white rocks to be seen from the bridge; one crystal 5 inches in diameter and crossed by another at 45°.

Chester, in aggregate of carbonate of lime, chlorite, and feldspar. Yellowish-green to white.

E. Emmons: Min. Loc.; Am. Jour. Sci., 1st series, Vol. VII, p. 254.

(The second citation is problematical. This aggregate occurs at the emery mine associated with long, yellowish-green prisms of epidote.)

1824. **Beryl.**

Six-sided prisms and amorphous. Often fine, delicate green; up to 5 inches in diameter. In granite in Chester and Norwich (Emmons). Also in similar and larger crystals in Worthington, sometimes whitish.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 43.

1825 **Topaz** (?). Goshen.

"Portion of a crystal nearly an inch in diameter, perfectly limpid, although when lying in its bed it has a delicate green tinge which is occasioned by the greenish crystals of mica which lie around. Fracture in one direction straight, in others conchoidal."

E. Hitchcock: Ibid., Vol. IX, p. 180.

(Afterwards called goshenite.)

1825. **Pyrophysalite.**

"Dr. Wright, of Goshen, pointed out to me a mineral at the locality of indicolite, etc., which he informed me was denominated by Mr. Nuttall the variety of topaz described by mineralogists under the above name. Its color is white, tinged with green, and on hot iron it phosphoresces very distinctly with a yellowish-green light and loses its color. It is opaque, or only slightly translucent. It is distinctly crystallized, but from the few specimens I obtained I could not determine the form."

E. Hitchcock: Loc. Min., Am. Jour. Sci., 1st series, Vol. IX, p. 21.

(Afterwards called goshenite.)

1825. **Iolite** (?). Goshen.

From the Barrus locality. Full description given.

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 395.

1825. **Beryl.** Norwich (Huntington). In the north part of the town.

In granite, a locality extraordinary for the regularity, transparency, and fine green color of the crystals, which occur from one-fourth to 4 inches in diameter. One superb crystal found in the earth near by 4½ inches in diameter and 6 inches long, with smooth and brilliant faces and rich green color.

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 607.

(This crystal was destroyed with the Shepard collection.)

1827. **Beryl.** Goshen, Chesterfield.

In granite veins, 2 to 3 inches in diameter and 5 to 6 inches long.

A. Nash: Lead mines of Hampshire County; ibid., Vol. XII, p. 259.

1828. **Beryl.** Norwich (now Huntington).

"Sought location" one-half mile west of Pitchers Bridge, near mass of white rocks to be seen from the bridge, described in Robinson's Catalogue.

No such white rocks can be seen west of the bridge, but a conspicuous, protruding mass of granite to the north; in this only one or two crystals of beryl occurred. It appeared also near the north line of the town.

E. Hitchcock: Min. Ex.; Am. Jour. Sci., 1st series, Vol. XIV, p. 219.

1835. **Beryl.** Chesterfield.

One foot in diameter.

E. Hitchcock: Geol. Mass., p. 506.

1838. **Phenakite.** Goshen.

"My first knowledge of the American mineral, which I take to be phenakite, was acquired about fourteen years ago, during a visit to the tourmaline locality in Goshen (on the farm of Mr. Weeks) in company with Mr. Nuttall and the late Dr. Hunt, of Northampton. My first impression was that it belonged to iolite, an opinion I afterwards changed in favor of the species beryl, under which name, I believe, it has generally passed in cabinets ever since. It should be remarked, however, that it was referred by some collectors for a time to topaz." Described.

C. U. Shepard: Am. Jour. Sci., 1st series, Vol. XXXIV, p. 330.

(Afterwards called goshenite.)

1841. **Beryl.** Pelham.

In gneiss in Pelham; a rather handsome yellow beryl; not abundant.

E. Hitchcock: Geol. Mass., p. 638.

1841. **Beryl.** Goshen, Chesterfield, Norwich.

"Many localities which yield few and not rich specimens." Several places in Goshen.

At the Weeks farm occurs a mineral of a rose color, but usually hyaline, which was formerly described as a rose beryl. Professor Shepard has, however, more recently described this mineral as the phenakite.

Am. Jour. Sci., 1st series, Vol. XXXIV, p. 330.

Dr. F. Tamnau, of Berlin, Prussia, to whom I sent specimens, says that "it seems not to be identical with the phenakite from the Ural and from Tramont [Framont], and I wish particularly to have more of it for a chemical analysis."

Chesterfield and Norwich. Beryls of great size, but poor; Norwich. In northwest part, very good; in Williamsburg and Worthington, quite elegant; also Warwick.

E. Hitchcock: Geol. Mass., p. 703.

1842. **Phenakite.** Goshen.

"A new examination of the sp. gr. satisfies me that it is not phenakite; sp. gr., 275-276, too low for phenakite; slightly superior to beryl, also slightly harder."

C. U. Shepard: Am. Jour. Sci., 1st series, Vol. XLIII, p. 366.

1844. **Goshenite.** Goshen.

C. U. Shepard: Treatise Min., 2d ed., Part I.

1844. **Beryl.** (*Beryllus hexagonus.*) Goshen and Chesterfield.

J. D. Dana: Sys. Min., p. 393.

1845. **Goshenite.** Goshen.

"I agree that goshenite, in the absence of well-determined crystals, rather than for the want of a good analysis (as you suggest), occupies a precarious position among my list of species."

C. U. Shepard: Reply to critique on mineralogy; Am. Jour. Sci., 1st series, Vol. XLVIII, p. 174.

1845. **Goshenite.** Goshen.

"A crystal of this substance lately obtained by me at the locality shows so nearly the angles of beryl as to remove all probability that these minerals can be shown to be crystallographically distinct."

C. U. Shepard: Various mineralogical notices, ibid., p. 176.

1854. **Goshenite.** Chesterfield.

Analysis proved it to be beryl.

J. W. Mallet: Am. Jour. Sci., 2d series, Vol. XVII, p. 180.

1866. **Beryl.** Northfield.

One mile northeast of village, on land of Simeon Lyman. In vein of graphic granite in mica-schist. Abundant crystals up to 10 inches. Pale greenish-white; tabular, ∞ P, 0 P.

Also on Northfield Mountain on road to Irving, in southeast corner of the town.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

1876. "**Berylite.** Variety, aquamarine. Chesterfield; rose-colored and white. (Goshenin) Goshen."

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College.

In this publication Professor Shepard proposed a new nomenclature. The termination *in* was to be used for varieties not yet established as valid, *ine* for good varieties, *ite* for species. The system has not been adopted.

1877. **Beryl.** Blandford.

Dark-colored and poor. Field north of church.

1879. **Beryl.** Chesterfield.

At spodumene location, Barrus farm, near Goshen. Small green crystals in coarse masses at Chesterfield Hollow.

A. A. Julien: Ann. N. Y. Acad. Sci. Arts., Vol. I, p. 319.

1882. **Beryl.**

Fine crystals have been found by Mr. J. T. Ames, of Chicopee, in the granite veins in the Monson quarry.

Mr. W. N. Flint, private communication.

1882. **Beryl.** Blandford.

A fine crystal 16 inches long and 12 inches in diameter was obtained at the feldspar quarry of the Pontoosuc flnt mills and presented to the Amherst College cabinet by Mr. F. L. Nason.

1882. **Beryl.** Northfield.

In Brush Mountain at tourmaline locality. Crystals up to 3 inches across, bluish, oil-green to colorless; largest 13 inches across, 78 to 80 pounds; 0 P, ∞ P. In some the prisms are molded into points at one end by intercrystallization with muscovite. Also found at columbite locality at John Moody's and east of gulf road, in granite. Discovered by Mr. M. A. Brown.

Collection of W. E. Webster, Northfield.

1885. Beryl. Huntington, Norwich Hill.

In extensive blasting at the spodumene ledge, done for me by Mr. F. L. Nason, only a few small prisms and irregular pieces were found, molded among other minerals. Of a reddish-yellow color.

1890. Beryl. Goshen.

Rude crystals more than a foot across, in granite north of the brook entering Lily Pond. Discovered by Mr. Alvan Barrus.

1890. Beryl. Goshen.

Two beautiful rose-colored beryls, over an inch across, have been found at Goshen, Mass., and are in the Gibbs cabinet at Yale University.

George F. Kunz: Gems and precious stones of the United States, p. 92.

BIOTITE.

1823. Macle. Chesterfield.

"According to Mr. Nuttall, the foliated mineral occurring so abundantly in the mica-slate in Chesterfield, etc., being usually inserted in small bronze-colored plates nearly at right angles to the bedding, may be macle."

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 227.

1824. Black mica. Pelham.

Fine specimens.

C. U. Shepard: Min. Loc., ibid., Vol. VIII, p. 235.

1838. Black mica. Brimfield.

Six-sided tables with iolite, good; 1½ miles northeast of village, on Warren road, near Samuel Patrick's.

J. W. Foster: Ibid., Vol. XXXIII, p. 400.

1841. Mica.

Described as a constituent of "spangled mica-slate," with expression of uncertainty as to its nature. Small bronze plates at right angles to bedding; brittle and inelastic.

E. Hitchcock: Geol. Mass., p. 594.

1852. Ottrelite. Near Goshen.

Abundant.

C. U. Shepard: Min., p. 161.

(This is the biotite forming the spangles of the "spangled mica slate.")

1866. Astrophyllite. Northfield.

"Black-lead mine," on land of Mr. Piper.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

(It is not cited in Shepard's Catalogue of Minerals of 1876, and is biotite. See 1886. Graphite, under GRAPHITE.)

1866. Biotite. Chester.

"I examined a specimen of the dark-green micaceous mineral which I took to be chlorite (the corundophyllite of Shepard), and from its purity expected to get a very accurate idea of its composition, but in the very commencement of the investigation it was found to be well-characterized biotite." Occurs on surface of indianite (Shepard) in small, thin, micaceous crystals perpendicular to surface; dark green.

1866. **Biotite**—Continued.

Analysis.

SiO_2	39.08
Al_2O_3	15.38
MgO	23.58
FeO	7.12
MnO	0.31
K_2O	7.50
Na_2O	2.63
H_2O	2.24
Fl	0.76
	98.60

J. L. Smith: Am. Jour. Sci., 2d series, Vol. XLII, p. 91. This is the "fringe rock" mica afterward named euchlorite by Shepard.

1868. **Phyllite** (Ottrelite). Goshen, Plainfield, Chesterfield.

Dana, Min., p. 506.

1870. **Corundophyllite.** Pelham.

Inclosing corundum, at the asbestos mine.

J. H. Adams, class of '70, Amherst College. Am. Jour. Sci., 2d series, Vol. XLIX, p. 271.

(This is biotite, and is optically negative, with decided biaxial character.)

1876. **Euchlorite** (Shepard). Chester.

Occurs in a layer several inches thick on both sides of an extensive vein of albite (should be oligoclase) 6 to 12 inches thick—"fringe rock." Description given.

Analysis.

SiO_2	35.51 to 38.46
FeO	15.52
Al_2O_3	6.80
HO	6.10
MgO (dif.)	38.07
	100.00

C. U. Shepard: Contrib. to Min., p. 2 (sep. pub.).

1876. **Ripidolite** (Clinochlore). Pelham.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 4. (Refers to the above citation.)

1876. **Euchlorite** (Shepard). Chester.

Un seul axe négatif comme les biotites. Cette composition étant celle d'un mica magnésien comme la biotite du Vésuve; l'euchlorite de M. Shepard n'est point une espèce particulière, mais une simple variété de mica.

Analysis.

SiO_2	39.55
FeO	7.80
Al_2O_3	15.95
MgO	22.25
Alkali	10.35
H_2O (loss)	4.10
	100.00

M. F. Pisani: Comptes Rendus, Vol. LXXXIII, p. 166.

1876. **Biotite.**

Great sheets, larger than one's hand, of jet-black shining biotite occur in coarse granitoid portions of the gneiss of the Monson quarry.

1876. **Ottrelite.** Chesterfield.

A slide of the "spangled mica-schist" is included in the series of slides to illustrate rock-forming minerals, sold by Prof. A. A. Julien and labeled ottrelite.

1887. **Biotite.** Goshen.

The so-called ottrelite or phyllite of the spangled mica-schist is optically uniaxial, negative, has the brown absorption colors, and all the properties of biotite. It occurs abundantly in the "calciferous mica-schist" (the Conway schists) and in the Devonian schists at Bernardston in small, elongate crystals set transversely to the foliation, as a result of later pressure. It shows abundant gliding planes from pressure, and is inelastic only when weathered. It is loaded with coaly matter and other impurities in the center and is free from inclusions in the outer portion.

1891. **Biotite.** Buckland.

In fine, large crystals in coarse granite south of Harris's soapstone quarry.

1892. **Biotite.** Pelham.

The wide fringe of deep bronze-colored biotite in aggregated scales surrounding the mass of olivine rock at the asbestos mine is discussed in the monograph on the area.

1892. **Phyllite** (under Ottrelite). "Goshen, Chesterfield, Plainfield, etc."

The mica of the spangled mica-schist is still retained in this relation, and reference is made to the fact that Wolff has found a similar mica in the Hoosac schists to be in part ilmenite.

E. S. Dana: A System of Mineralogy, p. 642.

1895. **Biotite.** Goshen.

The following analysis was made on material carefully selected by me from a typical specimen of the "spangled mica-schist" from the northern part of Goshen. The analysis was made in the laboratory of the Survey by Mr. George Steiger. The water determination was made by Dr. Arthur J. Hopkins, of Amherst College.

SiO_2	36.96
TiO_2	.91
Al_2O_3	21.15
Fe_2O_3	2.80
FeO	*15.54
CaO	.23
MgO	7.87
K_2O	7.47
Na_2O	1.00
H_2O	2.93
	96.86

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* Determination unsatisfactory, owing to the large amount of insoluble residue.

BITUMINOUS COAL.

1835. **Bituminous coal.** Sunderland, South Hadley, West Springfield.

In coarse, gray, micaceous sandstone and in bituminous shale and "marlite." The question of finding coal in workable quantity is discussed at length.

E. Hitchcock: Geol. Mass., pp. 43, 227.

1841. **Bituminous coal.** Sunderland, at Whitmores Ferry. In the north part of South Hadley.

On the north bank of the Westfield River, in West Springfield, at "Mitneag" (now Mitaneague) Falls. It occurs in the form of small and irregular veins, the coal also being filled with numerous thin veins and crystallizations of calcareous spar.

Analysis.

Volatile matter (water and bitumen)	22.00
Carbon	77.97
Earthy residuum	0.03
	100.00

E. Hitchcock: Geol. Mass., p. 138.

BORNITE.

1823. **Variegated pyritous copper.** Montague.

Sparingly disseminated in calcareous spar in sandstone of the coal formation. Island at Turners Falls.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 231.

1825. **Purple copper.** Chesterfield.

With green feldspar.

C. U. Shepard: Min. Loc.; Am. Jour. Sci., 1st series, Vol. IX, p. 48.

1841. **Variegated copper ore.** Chesterfield.

Is said to have been found in the Chesterfield granite.

E. Hitchcock: Geol. Mass., p. 704.

1891. **Bornite.** Charlemont.

Back of S. G. Turner's house in chlorite-schist, disseminated in grains as large as a pea. (Hawley.)

Near C. Colby's house. Large grains, an inch across, surrounded by malachite. One specimen in cubes. In quartz veins in chlorite-schist. A pit has been dug, and the ore is said to assay $6 per ton gold, $2.50 silver.

BREUNNERITE.

1844. **Breunnerite.** See Dolomite.

BROOKITE.

1865. **Brookite.** Chester.

"Rarely attends diaspore and corundophyllite."

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 123.

1865. **Brookite.** Chester.

A few crystals with diaspore.

C. U. Shepard: Report of Chester Emery Mine, p. 12.

1866. **Rutile, or Brookite.**

With diaspore. "Professor Shepard thinks he has sufficient evidence to pronounce it brookite."

J. L. Smith: Am. Jour. Sci., 2d series, Vol. XLII, p. 92.

1894. **Brookite.**

I have examined the best collections of Chester minerals, but have never seen brookite among them. The crystals studied by Shepard were destroyed in the burning of his collection at Amherst.

CALCITE.

1810. **Carbonate of lime.** Southampton lead mine.

B. Silliman: Bruce's Min. Mag., Vol. I, p. 64.

1818. **Carbonate of lime.** Southampton lead mine.

Yellowish crystals.

A. Eaton: Southampton adit; Am. Jour. Sci., 1st series, Vol. I, p. 137.

1818. **Laminated calcareous spar.** Deerfield, east of academy.

E. Hitchcock: Geol. Deerfield., ibid., Vol. I, p. 115.

1823. **Calcareous spar.** Chester.

Beautifully crystallized (Emmons).

J. Porter: Min. Loc., ibid., Vol. VI, p. 246.

1823. **Calcareous spar.** Southampton.

"A dodecahedron (hog-toothed spar). A short six-sided prism terminated by three-sided pyramid; same prism with all solid angles truncated."

Deerfield and Greenfield, in greenstone; Leyden and Conway, rhombs in coarse limestone.

E. Hitchcock: Geol. Conn., ibid., p. 211.

1823. **Satin spar.**

"In bituminous shale with ichthyolites at Sunderland."

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 236.

1823. **Argentine.** Southampton lead mine.

"Undulated, not parallel laminæ, of a pearly shining luster, often of a beautiful silvery white. Sometimes it is in thin plates which intersect and form small cells, containing crystals of calcareous spar. It occurs on very compact granite, and is also associated with fetid quartz. Is pure $CaOCO_2$."

Analysis.

CO_2	41.00
CaO	54.00
SiO_2	3.25
MgO, FeO	.75
	99.00

Professor Dewey: Ibid., p. 333.

1824. **Carbonate of lime.** Chester.

With chabasie and stilbite, 1 mile east of meetinghouse.

Six-sided tables, flat tables, six-sided prisms.

E. Emmons: Min. Loc., Am. Jour. Sci., 1st series, Vol. VII, p. 255.

1824. **Argentine**. Southampton.

The argentine from the Southampton mine occurs also grayish; it is beautifully phosphorescent on hot iron; the light a bright and strong yellow.

The mineral has been found in abundance at Williamsburg in considerable masses. Of a beautiful pearly luster and laminated.

Professor Dewey: Additional notices of argentine, ibid., p. 248.

1824. **Calcite**. Chester.

Crystals in mica-slate, six-sided, table truncated in all its angles, terminated by planes; lenticular from deep truncation of above six-sided prisms and six-sided pyramid. Hexahedral prism so truncated in alternate planes of extremities as to form pentagonal sides terminated by three pentagonal faces. Granular, highly crystalline. In layers in mica-schist. (Emmons.)

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 32.

1824. **Fibrous limestone**. West Springfield.

Fibrous in fine red sandstone.

E. Emmons: Ibid., p. 34.

1824. **Argentine**.

That at Williamsburg decrepitates.

C. Dewey: Geol. Berkshire, ibid., p. 34.

1825. **Fibrous limestone** (satin spar). West Springfield.

Falls of Agawam River, forming perpendicular veins one-fourth to one-half inch thick in red sandstone slate. Calcareous spar in veins in greenstone, and sometimes embedded in amethyst.

Emerson Davis: Min. Not.; ibid., Vol. IX, p. 252.

1825. **Pisolite**(?). In large quantity on Chicopee River, Springfield.

Robinson's Cat., p. 71.

1825. **Argentine**. Williamsburg.

"We have recently discovered the locality of argentine. It occurs in large masses of a superior quality. I think some pure masses will weigh tons."

Letter of Mr. Morris Dwight: Am. Jour. Sci., 1st series, Vol. IX, p. 176.

1827. **Argentine**. Northampton.

Northwest corner of Northampton, passing into Williamsburg, near galena vein. With calcite and fluor pseudomorphs.

A. Nash: Lead mines of Hampshire County, ibid., Vol. XII, p. 257.

1835. **Argentine**. Westhampton (northeast part, not Williamsburg).

Attached to south end of mass of granite are fragments of mica-slate and micaceous limestone much contorted. Part of latter changed into argentine by the action of the granite.

E. Hitchcock: Geol. Mass., p. 307.

1835. **Fibrous limestone**.

In new red sandstone. Fibrous, up to 1 inch thick, in shale on Westfield River in West Springfield, and at Sunderland. Stalactites at Sunderland Cave, on east of Mount Toby, several inches thick.

Ibid., p. 231.

1835. **Carbonate of lime**. Southampton lead mine.

In distinct crystals; a dodecahedron composed of two six-sided pyramids; a short six-sided prism acuminated by three faces; also some with solid angles of prism truncated; delicate straw-yellow.

Ibid., p. 502.

1844. **Calcareous spar.** (*Calcialus rhombohedrus.*) (Argentine.) Williamsburg, Southampton.

J. D. Dana: Sys. Min., p. 246.

1882. **Calcite.** Deerfield.

Of the minerals which succeed to the prehnite, calcite and datolite are the most important and most abundant, and generally replace each other in different veins. In some a large development of calcite occurs with much axinite; in others an equally large development of datolite.

Excepting quartz, all the minerals enumerated above as inclosures in prehnite occur as inclosures in the calcite which follows it, and when pieces where the latter is abundantly developed are thrown in acid and the calcite nearly dissolved away, specimens of great beauty are obtained, the delicate frostwork of sphenite, chalcopyrite, epidote, and the black stout axinites being set off against the brilliant luster of the etched calcite, the whole being sprinkled over with minute pale-green dodecahedra of fluor. It occurs abundantly in distinct crystals and drusy surfaces over the prehnite; $-\frac{2}{3}R$ small with rounded edges; 1^5 bristling over large surfaces; R^6, OR, $4R$ ∞R, R^3, with curved and striated faces; R^{12} with deeply striated faces and often distorted; R^7, $-\frac{1}{2}R^5$ the first striated parallel to $-\frac{1}{2}R$, and the former either acuminate or truncated by a single face of R. Other delicately suspended forms had at one end a single broad face of R and rose in a group of sharp scalenohedra at the other end. Everywhere the crystals were small and affected the most elongate forms with rounded edges and rounded, striated, and distorted faces, as if to imitate as closely as possible the prehnite with which they were associated, while on the datolite the forms $2R$ or $-2R$, R invariably appear in large perfectly transparent crystals up to 18 mm. in length, and with a luster equal to that of the datolite itself.

B. K. Emerson: The Deerfield dike and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 352.

1882. **Calcite.** Northampton.

Half a mile below Smith's Ferry, in trap tuff.

Large cavities filled with a fine white crystallization in scalenohedra (R^3, R) 15 mm. long.

The same forms occur also in Delaney's quarry farther south, near the north line of Holyoke.

1886. **Argentine.** Northampton.

In granite on road from Leeds to Haydenville.

1886. **Argentine.** Northampton, at quarry south of W. N. Moore's, east of Florence.

Quartz pseudomorph after argentine.

1887. **Calcite.** Southampton lead mine.

On quartz; R^3 and R, R^3, with rounded faces; wine-colored crystals 12 mm. long. Also in large white opaque cleavage faces.

Hatfield lead mine R^3 twinned on O. Three-fourths inch long, opaque white, R with edges beveled by R^3 1 inch across. Is the oldest mineral in the vein at both mines.

1889. **Calcite.** Bardwells Ferry.

West side of river in cut of canal railroad. South side of river, 150 rods west of Bardwells Station.

R^3, twinned, parallel to 0, 1 inch long.

1889. **Calcite after salt.** West Springfield.

In black, shaly sandstone above dam on the Westfield River, west of the town.

Hopper-shaped cubes of salt, one-half to three-fourths of an inch across, which had been enveloped in the black shale, have been replaced by fine-grained white calcite, and show on surface in white crosses, squares, and triangles. Have been called chiastolite, octahedrite, and spinel.

Specimen kindly given by Mr. J. S. Diller. The full history of this interesting pseudomorph is given under Salt.

1890. **Calcite.** Loudville, Southampton, lead mine.

Now altered into limonite; ∞ P, — ½ R; 5 mm. long. On quartz.

1890 **Satin spar.** Chicopee.

Fine, fibrous calcite, in broad veins, in new red sandstone, below dam near mouth of Chicopee River.

Analysis by C. L. Upton, class of 1891, Amherst College:

CO_2	42.26
CaO	53.59
Fe_2O_3	1.30
MgO	1.25
Insoluble	1.15
	99.55
Sp. gr	2.73

1890. **Concretions.**

Irregular concretions, septaria, occur in abundance in the upper shales of the Trias about Springfield and Chicopee.

Very regular and varied forms occur abundantly in the Champlain clays, especially in the banks of the river in Hadley and Montague.

1891. **Calcite.** Chester. Emery mine.

Form R; also same twinned parallel to — ½ R on magnetite.

1891. **Tufaceous incrustation from tube of artesian well at South Hadley.**

Analysis by C. L. Upton:

CO_2	38.21
CaO	46.79
MgO	5.46
Fe_2O_3	.80
Insoluble	5.51
	96.77

CASSITERITE.

1825. **Pyramidal tin ore.** Chesterfield.

Mohs. Min., Vol. II, p. 387. Haldinger's ed., Edinburgh.

1829. **Oxide of tin.** Goshen.

At the tourmaline locality a single hemitropic octahedron weighing about 50 grains.

E. Hitchcock: Tin in Massachusetts; Am. Jour. Sci., 1st series Vol. XVI, p. 188.

1832. **Tin.** Goshen.

"I am able to say with perfect confidence that this interesting mineral exists in Massachusetts, but can add little more. I found only a single crystal of its oxide, weighing 50 grains. But this I myself dug from a block of granite in the northeast [northwest] part of Goshen, and on reducing it to metallic tin it corresponds in every respect with that metal from England. I have never been able to find any more specimens."

E. Hitchcock: Geol. Mass.; Am. Jour. Sci., 1st series, Vol. XXII, p. 62.

1835. **Oxide of tin.** Goshen.

"The single crystal was an octahedron with square base, though the measurement of several angles did not agree with those given in the books."

E. Hitchcock: Geol. Mass., p. 509.

1841. **Oxide of tin.** Goshen, northwest part.

"In the sixteenth volume of the American Journal of Science I have given a particular account of the single crystal of oxide of tin which I found several years ago at the well-known locality of several interesting minerals in the northwestern part of Goshen; octahedron with square base. It occurs also in the granite of Chesterfield."

E. Hitchcock: Geol. Mass., p. 706.

1843. **Oxide of tin.** Chesterfield.

Stated to exist in Chesterfield (in Haldinger's edition of Mohs) in "small groups of black twin crystals," and in Dana's description. An analysis (by Hayes) here first given: Crystals P, ∞ P ∞—no twins.

J. E. Teschemacher: Description of the oxyde of tin at the tourmaline locality, Chesterfield; Trans. Assoc. Am. Geol., Vol. I, p. 296.

1862. **Cassiterite.**

Now frequently found in the granite of the adjoining towns of Goshen and Norwich (Huntington).

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XXXVII, p. 407.

1882. **Cassiterite.**

I have seen very fine crystals from Chesterfield (25 mm. long, wedged in interstices of tourmaline) in W. E. Webster's collection at Northfield, and fine specimens are preserved in the Shepard collection in Amherst College.

CELESTITE.

1835. **Sulphate of strontia.** West Springfield.

Radiated, on fetid Triassic limestone in West Springfield. Sp. gr. 4. In blowpipe test melts and tinges flame red.

E. Hitchcock: Geol. Mass., p. 232.

1858. **Celestine.** Holyoke. Meacham's quarry.

In Triassic sandstone.

E. Hitchcock: Catalogue of State Museum in Rep. of State Board of Agriculture, App., part xx, No. 107.

CERUSSITE.

1823. **Carbonate of lead.** In cavities of the matrix of the lead mine at Southampton.

White, mixed with yellow; decrepitates and yields lead. It occurs crystallized as follows: Two six-sided pyramids, united at their bases and deeply truncated at their apices, 14 faces; six-sided prism, terminated by four-sided pyramids, 2 of the faces enlarged, 14 faces; tabular prisms with bevelment on the edges. These tables frequently cross each other.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 234.

1825. **Carbonate of lead.** Loudville mine, Southampton.

Crystallized in right rhombic prisms; green carbonaceous from infiltrated malachite. Earthy, carbonaceous, reddish-brown, massive, and disseminated.

C. U. Shepard: Min. Loc.; ibid., Vol. IX, p. 249.

1835. **Carbonate of lead.** Southampton.

E. Hitchcock: Geol. Mass., p. 507.

1841. **Carbonate of lead.** Southampton.

E. Hitchcock: Geol. Mass., Final Rep., p. 705.

1885. **Cerussite.** Manhan lead mine, Loudville.

A cavity in quartz 5 cm. across, formerly filled by calcite—the quartz having penetrated the cleavage of the calcite on enveloping it—is lined by fine crystals 5 mm. long, which strikingly resemble quartz crystals in the development of their faces; they have adamantine luster, translucent, and are pale topaz color; on them rest two larger crystals of a later generation, 23mm. long, exteriorly colored like the others, interiorly flesh colored, verging on pink. Also beautiful six-rayed penetration twins occur, as in fig. 599 of Dana's Treatise on Mineralogy.

The smaller crystals mentioned above have the form P, ∞P, $0P$, penetration twins of two individuals; the larger $\infty P \breve{\infty}$, $\frac{1}{2} P \breve{\infty}$, P, $\infty P 3$; the domes horizontally striated and curving into each other.

The specimen is in the Clark collection of Smith College.

1892. **Cerussite.** Leverett, Hatfield.

Occurs rarely in the baryta veins on quartz and galena, forms P (111), $2 P \breve{\infty}$ (021), and stellate twins.

CHABASITE.

1818. **Chabasie.** Deerfield.

Considerably abundant crystals up to one-fourth inch occur in veins of greenstone, both in geodes, on balls of zeolite, on chalcedony, and on lamellar quartz.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1823. **Chabasie.** In cuboidal crystals at Chester (Emmons).

J. Porter: Loc. Min., ibid., Vol. VI, p. 248.

1823. **Chabasie.** Deerfield.

"Hundreds of specimens have been obtained at this place. To procure them, however, requires much labor."

E. Hitchcock: Geol. Conn. River, ibid., Vol. VI, p. 224.

1824. **Chabasie.** Chester.

Cuboidal crystals one-fourth inch across. Straw-yellow and white; fissures and veins in mica slate 1 mile east of meetinghouse in Chester.

E. Emmons: Min. Loc., ibid., Vol. VII, p. 254.

1844. **Chabazite.** (*Chabazius rhombohedrus.*) Chester.

J. D. Dana: Sys. Min., p. 340.

1882. **Chabazite.** Middlefield.

On arenaceous, black mica-schist; coating surface with wine-yellow rhombohedrons one-eighth inch across.

1882. **Chabasite.** (**Haydenite.**) Chester.

Crystals all simple, beautifully striated and aggregated, intergrown with stilbite on dark-gray mica-schist, three-sixteenths of an inch across. The finest specimens were destroyed in the burning of the Shepard collection.

1882. Chabazite. Cheapside, Deerfield.

At Cheapside it occurs in small, pellucid rhombohedra with delicately striated faces. Crystals 1 mm. in length. It rests always upon the trap, and never upon the heulandite with which it is associated, though when they come in contact the latter penetrates the chabazite and is the older mineral.

Farther southeast of Old Deerfield it occurs in the same association. Most of the specimens agree in all respects with those already described, but are whitened and opaque from incipient decomposition. Rarely much larger crystals occur, which are 6 to 8 mm. in length. These are quite fresh, the faces of good luster, but faceted in a very intricate manner, indicating that the twinning by which the apparent rhombohedra are built up has reached here an unusual complexity. The crystals are commonly twinned on 0, and in three cases very perfect twins, composition face R, occur, both halves being developed to perfect rhombohedra. In a single instance the apex of a crystal is replaced by three large, deeply striated faces of a flatter rhombohedron, apparently ½ R. The striæ run parallel to the combination edge of R and ½ R, and are plainly formed by the oscillatory combination of ½ R and 0. The character of the face did not allow accurate measurement. In thin fissures it incrusts broad areas, producing a tessellated surface made up of a great number of flattened crystals showing each a single face of R, the adjacent ones being in twin position and the whole reflecting the light together like a single face of a very large crystal.

B. K. Emerson: The Deerfield dyke and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 359.

1887. Chabazite. Monson. Flint's quarry, north end.

On horizontal joint surfaces on hornblendic gneiss bands in the biotite gneiss; broad surfaces of minute, aggregated, colorless rhombohedra, 1 mm. across, followed by stilbite.

1890. Chabazite. Greenfield.

Occurs in small colorless rhombohedra at the quarry opened in the west bluff of the trap for road material. It is just below the lookout on the crest of the range.

1891. Chabazite. West Northfield. Wood road west of E. L. Holton's.

On fissures of Bernardston (Devonian) mica-schist. Broad, thin squares one-half inch across, formed by the development of rhombohedra in a narrow space; striated; buff color from decomposition.

1891. Chabazite. Buckland.

In large, colorless rhombohedra in fissures in biotite gneiss, at the quarry on the railroad near Shelburne Falls.

1892. Chabazite. Chester. In amygdaloid.

E. S. Dana: Sys. Min., p. 592. Should be "in mica-schist."

CHALCOCITE.

1887. Chalcocite. Southampton lead mine.

In large masses; rare; surrounding chalcopyrite in layers 8 to 10 mm. thick, and itself surrounded by chrysocolla.

1888. Harrisite. Manhan lead mine, Loudville.

In thick black coating, having when thin a blue tarnish, on galena.

Both the above in the Clark collection in Smith College.

CHALCOPYRITE.

1810. **Copper pyrites.** Loudville.

B. Silliman: Bruce's Jour., Vol. I, p. 68.

1818. **Copper pyrites.** Greenfield. Banks of Connecticut River.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 115.

1823. **Pyritous copper.** Southampton, Leverett, Deerfield, Greenfield.

"At Leverett lead mine, amorphous. At Deerfield and Greenfield, in veins in greenstone and sandstone.

"At Southampton lead mine, where it occurs amorphous and crystallized in regular tetrahedrons, which are insulated on calcareous spar. For the specimens containing these crystals I am indebted to Dr. David Hunt."

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 231.

1826. **Pyritous copper.** Westfield.

"In bituminous marlite."

E. Davis: Rocks and minerals of Westfield, ibid., Vol. X, p. 215.

1832. **Pyritous copper.** Montague. On southern island at Turners Falls.

Rich, and in considerable quantity.

E. Hitchcock: Geol. Mass., p. 62; also Am. Jour. Sci., 1st series, Vol. XXII, p. 61.

1832. **Pyritous copper.** Leverett, Southampton.

E. Hitchcock: Geol. Mass., p. 507.

1838. **Sulphuret of copper.** Russell, farm of J. Gould.

In vein with blende and galena.

E. Hitchcock: Econ. Geol. Mass., p. 127.

1841. **Pyritous copper.** Greenfield.

"One vein on bank of Connecticut River, 100 rods below mouth of Fall River, the other a mile lower down; both several feet wide; in trap and sandstone; gangue, sulph-baryta and toadstone; green carbonaceous and pyritous copper.

On the south island at Turners Falls a vein of pyritous copper of rich quality and in considerable quantity. Indeed, several varieties of the sandstone rocks there seem to be impregnated with copper."

E. Hitchcock: Geol. Mass., p. 203.

1865. **Chalcopyrite.** Chester emery mine.

Few grains in margarite; upon joints of gneiss near the vein, with malachite.

C. U. Shepard: Report Chester emery mine, p. 12.

1882. **Chalcopyrite.** Greenfield, Cheapside, Gill.

Occurs disseminated in particles in the trap, in the prehnite, and in the calcite above (the latter rarely in tetrahedra up to 2 mm. in length), in cavities in the prehnite, and in minute, fresh-looking striated tetrahedra in calcite. Also on botryoidal diabantite and in the "chlorophæite" in Gill.

B. K. Emerson: Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 350.

1883. **Chalcopyrite.** Turners Falls. Island in river.

There was a very fine rich specimen in the Shepard collection, destroyed by fire in 1883.

1888. **Chalcopyrite.** Davis, Rowe.

Shipped as an ore from the Davis mine, disseminated in pyrite. Min. Resources of U. S. for 1887, p. 742.

CHIASTOLITE.

See Andalusite.

CHLORITE.

See Prochlorite.

CHLORITOID.

1865. **Masonite** (the variety near to ottrelite). Chester.

Is abundant at many places in the emery vein on the North Mountain.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 123.

1865. **Ottrelite** (masonite, chloritoid). Chester emery mine.

Belongs to the same group as margarite. In disseminated scales of a dark, blackish-green color, whose breadth is rarely more than one-fourth of an inch. They present considerable resemblance to mica, but when seen on weathered surfaces of the veins or on open joints of the rock are easily distinguished by their greater hardness and want of elasticity. It is chiefly confined to the stony emery, i. e., the chloritoidal rock or substance of the vein. Over 20 per cent FeO, 6 per cent H_2O. It stands in relation to mica somewhat as emery does to corundum.

C. U. Shepard: Report Chester emery mine, p. 10.

1876. **Chloritoidite.** Chester.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 4.

The biotite in transverse plates in the spangled mica-schist has often been called ottrelite (phyllite, Thomson, in Dana's Mineralogy). See citations under Biotite.

CHLOROPHÆITE.

1825. **Chlorophæite.** (J. W. Webster.)

Additions to the cabinet of minerals at Cambridge presented by Rev. Mr. Hitchcock; greenstone containing rounded nodules of a dark-green color, which on examination I find to be chlorophæite.

J. W. W.: Bost. Jour. Phil., Vol. III, p. 610.

1826. **Chlorophæite.** Turner's Falls, Gill.

"Trap rocks about Turner's Falls, in Gill. (Determined by J. W. Webster.) Is in radiating masses, pea to bullet size, several frequently united. Sometimes cavities partly filled with calcite. Newly broken yellowish-green or dark bottle-green, sometimes semitransparent; darkens on exposure; this is obvious in one-half hour in sunlight; in a few hours is nearly black, and then radiated structure becomes less and less distinct and in some black specimens is scarcely to be discerned; at surface all nodules are changed to black, dark-green, or the dull muddy-green of steatite, and the same an inch or more into the rock. Some specimens are of dark-cinnamon color, others long exposed become covered with a rusty powder; it is so soft as easily to be scratched by the finger nail. Occurs 80 rods below the falls on the north side, and 20 to 30 rods above the mouth of Fall River. To be distinguished from chlorite (delessite), which is in folia. The chlorophæite is in minute acicular needles."

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. X, p. 393.

1835. **Chlorophæite.**

"It appears to be decomposed mesotype."

C. U. Shepard: Min., 1st ed., Vol. II, p. 125.

1841. **Chlorophæite.** Gill.

"This mineral when the rock is first broken is of a dull-green color, but after a few hours' exposure it becomes nearly black; after long exposure, however, some specimens assume a dark-brown color. For the most part, the nodules—often half an inch and sometimes more than an inch in diameter—exhibit a fibrous structure, the fibers radiating from one or more centers in the same nodule. The mineral is easily scratched with a knife, and the powder is of a dull-green color. When fractured, however, it appears brittle, and sometimes calcareous spar is inclosed in the chlorophæite, but very rarely are the nodules hollow. If I mistake not, in one or two instances I have observed a foliated structure in the specimens; associated with prehnite, chlorite, and pyritous copper; the rock only slightly amygdaloidal."

E. Hitchcock: Geol. Mass., p. 660.

1852. **Chlorophæite.**

Stands in close connection with chlorite or green earth.

C. U. Shepard: Min., 3d ed., p. 151.

1878. **Chlorophæite.** "Gill, in Massachusetts, and Turners Falls, in Connecticut."

P. Groth: Min. Col., Strasburg, p. 258.

(Turner's Falls is in Gill.)

1882. **Products of the decomposition of prehnite (chlorophæite of Hitchcock).**

The mineral chlorophæite, described by Macculloch in 1825, but not analyzed, proves now, from the analysis of Heddle,[1] to be of very different composition from the highly hydrated protoxide of iron silicate analyzed by Forchhammer, with which it has been associated. It is a magnesian peroxide of iron silicate, with about 25 per cent of water, sometimes aluminous, and it approaches thus more nearly to diabantite, from which it differs mainly in the peroxidation of the iron and in containing double the quantity of water.

In 1825 President Hitchcock discovered a mineral "in the trap rocks about Turners Falls, in Gill, Mass.,[2] which Prof. J. W. Webster, of Harvard University, pronounced to be the chlorophæite of Macculloch." The description given by President Hitchcock agrees so exactly with that of Macculloch and Heddle, and the rapid blackening of the mineral is so peculiar, that the reference was very natural, and I think correct.

On examining slides of the "smoked" prehnite[3] last described, its radiated needles were in the center colorless and perfectly fresh, and contain in abundance scales of diabantite, with remarkably strong dichroism brown-green to black. Although the smoky, black mass resembled closely an amygdule of the chlorophæite, its great hardness and the crystalline surface proved it to be prehnite, and the peculiar striation dependent upon the arrowhead twinning was quite as characteristic. Toward the outer surface, however, the mass softened rapidly and could be readily impressed by the finger nail, and under the microscope the fibers were seen to change quite rapidly into an amorphous or fine, scaly material of red-brown color, showing faint aggregate polarization, but no dichroism. Farther in among the clear needles portions of the mass have all the needles likewise stained brown superficially. On examining President Hitchcock's original speci-

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[1] Trans. Royal Soc. Edinburgh, Vol. XXIX, p. 84.

[2] Am. Jour. Sci., 1st series, Vol. X, p. 393.

[3] See Prehnite.

1882. Products of the decomposition of prehnite—Continued.

men, No. 91 of the last catalogue of the Massachusetts State collection,[1] it was found to be distinctly radiated from several centers, the fibres of the same size and arrangement as those of the fine fibrous prehnite, and a fragment broken from the specimen gave a pale-green powder and scratched apatite without difficulty. The cavity in which it is found is lined first with the foliated diabantite, then follows inwardly chalcopyrite, chlorophæite, the latter occupying thus the same place as the prehnite in the unaltered nodules.

Under the microscope traces of the bright quartz-like polarization and the peculiar striation of prehnite could be clearly seen. The latter mineral was, however, for the most part changed into a red-brown, indistinctly scaly mass, with very faint polarization. The fibers of the original prehnite had not been at all fused together or changed in their relation to each other, and nothing was interposed among them. Other nodules completely changed showed also the network of black material between the needles. In specimen No. 92 of the same collection with H. 1.5, the fibrous structure is much less distinct than in the former one; both are of the same dull, black color, but under the microscope it is seen to be made up of the same faintly scaly red-brown material arranged in radiated needles exactly as before, but now showing no trace of the further presence of unchanged prehnite. The brown material is not to be distinguished under the microscope from that which results from the change of diabantite, except that in each case the structure of the original mineral is retained.

In other cases the change of the prehnite has taken another course. In the variety from the new cutting at Cheapside, where the lustrous bars of the mineral are interwoven with minute green fluor, the bars change toward the side where the fissure in which they were formed opened into the main vein, gradually into a pale-green scaly mass which retains for a distance the shape of the bars and their relation to the fluor, but farther on is blended into a pale-green mass with satiny luster, which looks as if it had been worked up into a paste and dried in a thin layer upon the surface. Similar masses are found abundantly, especially in the datolite, and under the microscope still contain fragments of fresh unchanged prehnite.

The mineral itself is under the microscope seen to be made up of loosely aggregated scales and to show a bright green color and a dichroism, both like that of diabantite. It is apparently hexagonal, many scales remaining black during a complete revolution between nicols. Its lighter color seems to be the result of its different aggregation, and the powder of both is of the same light green. Prehnite can thus change into a mineral very similar to, if not identical with, diabantite (enough pure material for an analysis could not be obtained), and both the prehnite and the common scaly radiated diabantite change into red-brown almost amorphous materials which can not be distinguished microscopically.

I have assumed, on what seems good grounds, that the diabantite which fills the fibrous prehnite so often was formed at the same time with the latter, and it often shows a zonal arrangement in the prehnite which goes far to show that this was so, and in the specimens the two cases[2] can be easily distinguished. On the other hand, I think the change of the prehnite is primarily into the green diabantite-like mineral and through

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[1] State Board of Agricult. Report, Vol. VI, Appendix, p. 16, where the mineral is printed "Chlorophocite."

[2] That of the diabantite originally inclosed in the fresh prehnite and the similar scaly mineral formed by the decomposition of the latter.

1882. Products of the decomposition of prehnite—Continued.

this into the brown peroxidized substance, and that the instability of the first or protoxide stadium of the substance is the condition of its rapid change from green to brown or black when exposed to the air. Indeed, this is also a striking characteristic of the common diabantite itself, and fresh trap specimens lose their green tint and soon turn brownish-black if exposed to the weather, though the change does not occur with such remarkable rapidity as in the case with the prehnite-diabantite, or chlorophæite. Professor Heddle explains the sudden change of color by shrinkage-cracking, due to partial dehydration.

B. K. Emerson: The Deerfield dike and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 276.

CHONDRODITE.

1884. **Chondrodite.** Middlefield.

Occurs in the pre-Cambrian limestone at the mouth of Coles Brook, at the railroad cutting, west edge of large bed, in reddish and grayish grains changing into serpentine. It can also be found at various places in the band of limestone which extends from this point north to the school at Factory Hollow.

CHROMITE.

1820. **Chromate of iron.** Cummington.

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. II, p. 374.

1823. **Chromate of iron.** At Cummington soapstone quarry.

Only a small mass has as yet been discovered.

J. Porter: Min. Not., ibid., Vol. VI, p. 248. There is no soapstone quarry in Cummington. The quarry in Windsor, cited below, which is near the Cummington line, must have been meant.

1823. **Chromate of iron.** Cummington, Middlefield in serpentine (Eaton).

Cummington, well characterized and almost resembling the Baltimore chromate; in a loose mass found by Dr. J. Porter.

E. Hitchcock: Geol. Conn. River, ibid., p. 233.

1833. **Chromate of iron.** Cummington. Blandford.

"While the second edition of this work was passing through the press I have discovered the chromate of iron in serpentine in Blandford; specimens 4 to 5 pounds weight."

E. Hitchcock: Geol. Mass., p. 52, 366; also Am. Jour. Sci., 1st series, Vol. XXIV, p. 397.

1835. **Chromate of iron.** In the east part of Windsor, near soapstone quarry, in serpentine.

E. Hitchcock: Geol. Mass., p. 363. Cummington, Blandford, ibid., pp. 52, 369.

1838. **Chromate of iron.** Chester.

Report of Dr. H. Holland. Appears in the eastern portion of the serpentine; three outcrops 5 to 18 inches wide; 1,200 pounds of ore obtained; one mass pure, 60 pounds; trace of platinum. CrO 52–53, FeO 33–35. Salts prepared from it are in the State collection.

E. Hitchcock: Econ. Geol. Mass., p. 124.

1841. **Chromate of iron.** In serpentine, 5 miles northwest of Blandford, on Becket road.

Tuberculous masses rarely as much as a foot in diameter; in masses a few inches in diameter; contains 30 per cent of oxide of chrome (Dr. H. Holland). A few miles north in the west part of Chester, near the railroad, on branch of Westfield River, a much larger vein was discovered by Dr. Holland. It is situated in the eastern portion of the serpentine, perhaps 300 feet above the railroad, where it cuts through the serpentine, and on the same side of the river. Said by practical chemists to afford 43 per cent CrO (Holland).

Analysis (by Dr. Hitchcock).

CrO	34.63
Fe_2O_3	50.65
SiO_2	9.27
Al_2O_3	5.45
	100.00

E. Hitchcock: Geol. Mass., 1841, pp.191, 618.

1882. **Chromite.** Pelham.

From the serpentine near the asbestos mine. In grains 3 to 5 mm. in diameter.

CHRYSOCOLLA.

1876. **Chrysocollite.** (C. U. Shepard.) Southampton lead mine.

C. U. Shepard: Cat. of Min., within 75 miles of Amherst College, p. 3.

1888. **Chrysocolla.** Manhan lead mine, Southampton.

In layers 5 to 10 mm. thick, coating cuprite and chalcopyrite; rare; finest specimens in Clark collection in Smith College.

CHRYSOLITE.

1876. **Pelhamine.** (C. U. Shepard.) Pelham.

"Singular seams and masses, sometimes a foot thick at the asbestos mine, associated with bronzite and talcite; tough and so not serpentine; lusterless; powder dark greenish-gray; H. =5; Gr. =2.9—3.2. B. B. infusible, but turns cinnamon-red; not decomposed by acids.

Analysis.

SiO_2	38.40
FeO	15.52
Al_2O_3	2.80
H_2O	3.40
MgO (dif.)	39.88
	100.00

C. U. Shepard: Contrib. to Min., p. 3. (Priv. pub.)

1876. **Pelhamine.** Pelham.

Is allied to chrysolite.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 5.

1881. **Olivine.** Pelham.

The black, tough masses at the Pelham asbestos quarry called pelhamine by Shepard prove upon microscopical examination to be a colorless chrysolite in intimate mixture with chromite and other oxides. It makes the mass of an immense intrusive neck in the Becket gneiss as the principal ingredient of an olivine rock which contains much magnetite and little bronzite and is separated from the gneiss by a broad band of biotite, anorthite, corundum, and apatite of so much special geological interest that it is described at length in the forthcoming monograph upon the geology of the region.

1883. **Olivine.** Shutesbury, New Salem.

The so-called serpentine masses in the centers of these two towns are largely olivine, in the same position in the gneiss and with the same associated minerals, in part, as in the Pelham locality. In all these localities the mineral is of so much more lithological than strictly mineralogical interest that I have discussed it under the former head, as indicated above.

1883. **Olivine.**

A pale olive-green olivine in crystalline grains .5 mm. to 2 mm., superficially reddened by decomposition, in a light-gray amygdaloid bowlder in the till on the north slope of Mount Holyoke, just west of the Notch.

1884. **Pelhamine.** Pelham.

The serpentinous substance called pelhamine by Prof. C. U. Shepard admits of a good polish and with a very curious effect.

Kunz: Precious stones; Min. Res. of the U. S., 1883–84, p. 776. Gems and precious stones, 1890, p. 189.

1885. **Olivine.** South Hadley.

I have never with certainty detected olivine in the large Holyoke and Deerfield diabase beds, but in the later volcanic necks, especially in that north of Moodys Corners, small brick-red decomposed olivines are quite frequent.

CLINOCHLORE.

1879. **Clinochlore.** North Blandford.

In coarse, large, foliated masses at Bartholomew's soapstone quarry, Blandford.

Similar occurrence at Osborne's soapstone quarry. Optically positive. Quite strongly biaxial. Dichroic green and red; weakly so with microscope. Very dark green, in broad plates much cut by gliding planes.

1889. **Clinochlore.** Chester.

Pseudomorph. Mixture of epidote and clinochlore after hornblende.

In the collection of E. B. Underhill, formerly of Hallocks Mills, Westchester County, N. Y., which was bequeathed to Amherst College, was a specimen labeled "Chloritoid pseudomorph after hornblende, Chester, Mass." This collection was labeled, as he informed me, by Mr. J. S. C. Bailey, who, I believe, largely formed the collection; and as Mr. Bailey has collected extensively in Chester, I presume he obtained the specimen there. It came manifestly from the cutting near the railroad station from the white granular quartzite, containing shining, black hornblende blades, and I have since found it at that place. These are here changed centrally into pale pistachio-green granular epidote and dark-green chlorite having the optical properties of clinochlore. The blades are above an inch long and one-third of an inch wide.

1892. **Clinochlore.** Orange.

Soapstone quarry at southwest corner of Big Tully Mountain. In broad plates of clear green in granular dolomite and impure talc. Optically positive and nearly uniaxial.

COBALTITE.

1820. **Arsenate of cobalt.** Sturbridge, Monson.

Disseminated in small quantities in a large mass of hornblende connected with the graphite of the Sturbridge mine.

In hornblende rock in Monson; in hornblende rock on west side of Connecticut River Dr. Hunt found arsenide of cobalt.

A. Eaton: Index, pp. 118, 139.

1825. **Arsenate of cobalt.** Monson.

In primitive trap in small quantity.

A. Eaton: Index; Robinson's Cat., p. 61.

(No further notice of this mineral. Much whitish pyrite occurs at the Sturbridge mine and in hornblende-schist at the Monson quarry.)

COLOPHONITE.

See Garnet, 1823.

COLUMBITE.

1829. **Stanniferous columbite.** Chesterfield, Goshen.

In a loose stone in the foundation of a stone fence (at a little distance from the south end of the tourmaline ledge), in feldspar, beryl, and mica, 15 to 400 grains in size—1,400 grains in all; sp. gr. 6.00; crystal figured; contains columbic acid, tin, iron, manganese, lime trace.

Also at Goshen, at Weeks's farm, and 4 miles east of first location of spodumene. Small imperfect tabular crystals in spodumene.

C. U. Shepard: Discovery of columbite in Chesterfield, Mass.; Am. Jour. Sci., 1st series, Vol. XVI, p. 220.

1835. **Columbite.** Chesterfield, Goshen.

Chesterfield tourmaline locality. Right rectangular prism, several modifications; two places in Goshen in spodumene. (Shepard.)

E. Hitchcock: Geol. Mass., p. 509.

1835. **Columbite.** Chesterfield.

The columbite of Chesterfield consists of the oxides of columbium, tin, iron, manganese, with trace of lime. More distinct crystals (than from Haddam), and of greater size, come from Chesterfield.

C. U. Shepard: Min., 1st ed., Vol. II, p. 140.

1841. **Columbite.** Chesterfield, Goshen.

At tourmaline locality in Chesterfield, and also at two places in Goshen, embedded in spodumene.

E. Hitchcock: Geol. Mass., p. 704.

1844. **Columbite.** Chesterfield.

Small crystals; brilliant, transparent, dark ruby-red.

J. S. Teschemacher: Bost. Jour. Nat. Hist., Vol. IV, p. 502.

1866. **Columbite.** Northfield.

"Sent me last autumn by Mr. M. A. Brown, of Springfield, Mass.; found on land of Mr. Simeon Lyman, 1 mile northeast of village. In much disintegrated graphic granite in mica-slate; tolerably well crystallized, black and shining; sp. gr. 6.5. Nearly identical with the Bodenmais variety. Supply limited."

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

1876. **Columbite.** Northfield, Chesterfield, Goshen.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 7.

1882. **Columbite.** Northfield.

In granite vein in lane one-half mile east of John Moody's house. Mr. M. A. Brown got $400 worth. Also with beryls. Best crystals went to Prof. George A. Brush.

Good crystals in W. E. Webster's collection, Northfield. Locality exhausted.

1883. **Columbite.** West Chesterfield Hollow.

Crystals 1 inch long; striated curiously, as if molded when soft.

In W. E. Webster's collection, Northfield.

1886. **Columbite.** Northfield.

Is almost a tantalate, with 57 per cent Ta_2O_5 and 27 per cent Nb_2O_5, and sp. gr. 6.84. Agrees with the general habit of columbite, as it has the same faces, and—in so far as one can judge from the imperfect measurements—the same angles. The crystals, which are large and rough, show the common rectangular habit with the faces *a* (100), $\infty \bar{P} \infty$; *b* (010), $\infty \breve{P} \infty$; *c* (001), $0 P$; *m* (110), ∞P; z (530), $\infty \bar{P} \frac{5}{3}$; k (103), $\frac{1}{3} \bar{P} \infty$; *n* (163), $2 \breve{P} 6$; *c*: k = 20°; *b*: z = 63°.

E. S. Dana: Ueber den Columbit; Zeit. Krys., Vol. XII, p. 266. Abstract Am. Jour. Sci., 3d series, Vol. XXXII, p. 386.

COOKEITE.

1879. **Cookeite.** Chesterfield, in cleavelandite.

A. A. Julien: Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 351.

1882. **Cookeite.** Chesterfield.

Fine specimen in W. E. Webster's collection, Northfield, Mass.

COPPER.

1823. **Native copper.** Whately.

In geest on the limit between the primitive and alluvial soil, and about 5 miles from the secondary greenstone of the coal formation. The piece weighs 17 ounces, exhibits imperfect rudiments of octahedral crystals on the surface, and is incrusted by green carbonate of copper. The cavities also contain a very little red oxide of copper.

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. VI, p. 230.

1843. **Copper.** Whately.

"The first piece of copper was found along the line of junction between the sandstone and the primary rocks in a plowed field; the second piece 2 miles farther to the west among the hills. I incline to the opinion that neither of these specimens originated in the trap or the sandstone, but in the primary rocks to the north of the places where they were found. They were mostly coated by the green carbonate and the red oxide (?). The last specimen was partially covered also with crystals of quartz deeply implanted. The extremities of these have all been broken off in efforts to cut the specimens into pieces, but their lower extremity may still be seen in the only fragment of this fine specimen which can now be found and which I lay upon the table with the former specimen uninjured."

E. Hitchcock: Ann. N. Y. Acad. Sci., 1843; also Am. Jour. Sci., 1st series, Vol. XLVII, p. 323.

1843. Copper—Continued.

The word geest above was used to designate the drift and the diluvial gravels.

Similar bowlders of copper have been found in Connecticut within the limits of the red sandstone, and a fine specimen is preserved in the Yale College cabinet. Those mentioned above doubtless came from the neighborhood of the trap, apparently reduced by it from older copper veins. It is hard to see how the pieces can have been carried south 10° west from the trap in Greenfield to Whately by the ice. Perhaps they had been lost there by the Indians.

The first specimen mentioned above is in the mineral collection of Amherst College. There are several cavities upon the surface from which quite large crystals apparently of calcite have been removed.

A specimen of native copper is in the museum of Amherst College having this label in President Hitchcock's handwriting: "Native copper found in drift 200 rods west of the meetinghouse in Whately, and on the farm of Rufus Dickinson, and presented by him and Dennis Dickinson to the college cabinet. Weight, 2½ pounds."

CORDIERITE.

1835. Iolite. Goshen.

"Stated to have been found in Goshen. I have not met with it."

E. Hitchcock: Geol. Mass., p. 507.

Refers to the "goshenite" of Goshen. (See under Beryl.)

1838. Iolite. Brimfield.

One-half mile northeast of village on road to Warren, near house of Samuel Patrick. In granite; violet-blue; no crystals; found 1835; with molybdenite, black mica, and garnet.

J. W. Foster: Am. Jour. Sci., 1st series, Vol. XXXIII, p. 399.

(The molybdenite is graphite.)

1844. Iolite. (*Hyalus bicolor.*) Brimfield.

J. D. Dana: Sys. Min., p. 406.

1886. Cordierite. Brimfield, Sturbridge.

On the west side of the road to Warren, and near the town line, 1 mile north of Elisha Marsh's house. In coarse granite associated with moonstone-like orthoclase, precious garnet, and fibrolite; deep blue to colorless; in granular masses up to the size of a robin's egg. Also found on the top of Shumway Hill, in Sturbridge, by G. H. Haynes, of the class of '87 in Amherst College, in larger darker masses in same rock.

1890. Iolite. Brimfield.

In gneiss with andalusite.

Kunz: Gems and precious stones of the United States, p. 159.

(Incorrect; should be "in granite with fibrolite").

1892. Cordierite. Ware.

In the first cutting south of the station on the Central Railroad. In deep-blue granular masses. The fibrolite schist is here full of veins and twisted lenses of pegmatite, and the cordierite is contained in these near their borders, and at times rounded blebs of the deep-blue mineral are inclosed in the chatoyant carlsbad twins of orthoclase.

CORUNDOPHYLLITE.

1865. **Chloritoid.** Chester.

C. T. Jackson: Am. Jour. Sci., Vol. XXXIX, p. 87.

1865. **Corundophyllite.** Chester emery mine.

Mineral not fully analyzed. Imperfect examination made upon a few grains of it found along with the sapphire of Buncombe, N. C., lead to the conclusion that it, like the ottrelite, is a silicate of alumina and iron with but little lime and magnesium. Des Cloizeaux has described it as one of the micaceous minerals, but it rather appears to belong to the clinochlore group. Its crystallization is near to mica; H.=2–3. Inelastic, almost brittle; in color and in the arrangement of its particles, even when giving rise to a slate, as it often does, it does not resemble the well-known mineral chlorite. It is of all others the most abundant gangue mineral of the purer varieties of both emery and magnetite.

C. U. Shepard: Report Chester emery mine, p. 10.

1865. **Corundophyllite.** Chester.

Abundant; called chloritoid by Dr. Jackson.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 112.

1866. **Corundophyllite.** Chester.

Analysis (given below in 1868) from material supplied by Prof. C. U. Shepard, with description; referred to ferriferous clinochlore (ripidolite).

F. Pisani: Ibid., Vol. XLI, p. 394.

1866. **Corundophyllite.** Chester.

The author obtained the species at Chester and sent a specimen to Professor Shepard, asking if it was his corundophyllite. On being informed that it was he then analyzed the specimen. It proves to be both chemically and physically a chlorite of the variety ripidolite.

Analysis.

SiO_2	25.06
Al_2O_3	30.70
FeO	16.50
MgO	16.41
H_2O	10.62
	99.29

J. L. Smith: Emery mine at Chester, ibid., Vol. XLII, p. 92.

1866. **Chloritoid.** Chester.

An analysis given under the name chloritoid, which is criticised by Dana as incorrect.

C. T. Jackson: Am. Jour. Sci., 2d series, Vol. XLII, p. 107.

1866. **Corundophyllite.** Chester.

In a letter Professor Shepard claims that the true corundophyllite is that from Asheville, N. C. He has, however, published the mineral at Chester as corundophyllite.

J. D. Dana: Ibid., p. 269.

1866. **Corundophyllite.**

Admits the chloritoid of Jackson and the clinochlore of Smith to be clinochlore. The mineral attached to the fringe rock, and analyzed by Professor Smith and found to be biotite, he now claims to be corundophyllite, as it has H.=1.5; inelastic; sp. gr. 2.76. Before the blowpipe it hardens, and melts with difficulty.

C. U. Shepard: Ibid., p. 421.

1867. Corundophyllite. Chester.

Is clinochlore, optically.

J. P. Cooke: Some American chlorites; Am. Jour. Sci., 2d series, Vol. XLIV, p. 206.

1867. Corundophyllite.

"Corundophyllite is a clinochlore in plates or crystals; bisectrix positive, inclined."

Des Cloizeaux: Letter to Prof. J. D. Dana; ibid., pp. 258, 283.

1868. Corundophyllite. Chester.

Analysis by Prof. J. H. Eaton. Column No. 1, crystals with diaspore, rutile, and sapphire. No. 3, fringe rock. No. 2 is by Pisani. Professor Shepard states that he supplied the same material for Nos. 1 and 2.

	No. 1.	No. 2.	No. 3.
SiO_2	24.77	24.0	24.69
Al_2O_3	25.52	25.9	28.52
MgO	21.88	22.7	21.86
FeO	15.19	14.8	16.38
H_2O	11.98	11.9	([1])
	99.34	99.3	....

[1] Not determined.

C. U. Shepard: Ibid., Vol. XLVI, p. 257.

Analysis No. 3 of the fringe rock is also corundophyllite, with probably a slight error in the Al_2O_3 determination. It is very different from the analysis of the fringe rock, by J. L. Smith, which is given under Biotite, 1866.

1891. Corundophyllite. Chester.

In an elaborate work upon the chlorites, Professor Tschermak describes the mineral fully and determines its optical characteristics. His results are made the basis of the description of the mineral by E. S. Dana in the new edition of the Manual of Mineralogy.

G. Tschermak: Die Chloritgruppe; Sitzungsberichte d. Akad. Wien, XCIX, p. 210.

1894. Corundophyllite. Chester.

The mineral is uniformly the oldest in the veins in magnetite, in which it occurs, and where it is not covered by later growths forms surfaces of hexagonal prisms, tapering by irregular steps from the larger attached end. It is followed by rutile, corundum, anorthite, diaspore, margarite, and calcite. Its growth continues in lessened degree through this series, small crystalline plates being perched upon the corundum blades or wholly inclosed in calcite, where it is followed immediately by margarite; broad sheets of it run up between the laminæ of the margarite. Some very beautiful crystals of dark-green color are capped by colorless or pale aquamarine colored heads. The transition is sudden, and the prisms below have colorless centers. The heads have perfect faces, in forms like fig. 7, p. 645, in the new edition of the System of Mineralogy (E. S. Dana), and, like it, are divided into irregular twinned segments. They are almost uniaxial. I can not distinguish these pale-green forms from amesite (q v.), and I have noted the apparent passage of the one mineral into the other. The material seemed perfectly fresh.

CORUNDUM.

1865. **Emery.** Chester.

First announcement with description and analyses. Considers it a distinct species. FeO,Al_2O_3.

C. T. Jackson: Am. Jour. Sci., 2d series, Vol. XXXIX, p. 87.

1865. **Corundum.** Chester.

White massive corundum in veins one-half inch wide occurs traversing massive emery. The latter mineral at Chester is exceedingly uniform in composition and may be regarded as an aluminate of protoxide of iron; FeO,Al_2O_3.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 123.

1865. **Corundum.** Chester.

Rare; only in seams one-half to three-fourths inch thick, though many 1 foot square; grayish white, highly crystalline, like that from the Carnatic; in granular and compact emery.

C. U. Shepard: Report of Chester emery mine, p. 9.

1865. **Emery.** Chester.

(*a*) No perfect crystals; coarsely massive or in large separate individuals up to one-half inch across; perfect cleavage and striæ; reddish-brown with faint coppery luster; 0.5, higher sp. gr. than corundum; abrading power ½; magnetic, FeO,Al_2O_3.

(*b*) Granular, flattened grains one-eighth to one-half inch in corundophyllite; formed from fusing of grains.

(*c*) Compact, very fine grained, tough, massive, harsh dark-brown, faint violet-blue tarnish in wedge-shaped, contorted masses or elliptical balls 5 to 10 inches across.

(*d*) Emery magnetite, massive magnetite, containing emery harder and tougher than magnetite, and has purple tarnish.

(*e*) Stony emery—the general substance of the vein, or the chloritoidal rock—slaty, tough, greenish-gray, very heavy, 10 to 20 per cent emery.

C. U. Shepard: Report Chester emery mine, pp. 6–8.

1865. **Emerite.** Chester.

"And he (Dr. Jackson) has suggested that it be considered a distinct species in place of being included under corundum. (Note.—Should it hereafter be found proper to separate emery from corundum, the name emerite ought not to be an unsuitable designation for the new species.) His conclusion would obviously be acquiesced in were it not for the strong resemblance in striæ and cleavage between the emery and common corundum, making it impossible for us to separate the substances crystallographically from one another. It would, however, be singular if two minerals differing so widely in their other physical qualities should be specifically identical."

C. U. Shepard: Report Chester emery mine, p. 6.

1866. **Emery.**

Dissents from the opinion of Messrs. Jackson and Shepard that emery is a separate mineral and gives several analyses:

	Poor.	Better.	Prepared.	Crystals.	After HCl and H_2O.
Al_2O_3	44.01	50.02	51.92	74.22	84.02
Fe_3O_4	50.21	44.11	42.28	19.31	9.63
SiO_2	31.30	3.25	5.46	5.46	4.81

H. Lawrence Smith: Am. Jour. Sci., 2d series, Vol. XLII, p. 83.

1866. **Sapphire.** Chester.

In dolomite veins, at Chester emery mine.

C. T. Jackson: Proc. Bost. Soc. Nat. Hist., Vol. XVI, p. 32.

1868. **Corundum.** Chester.

Occasionally in blue bipyramidal crystals.

J. D. Dana: Sys. Min., p. 139.

1870. **Corundum.** Pelham.

Nodules of brownish-black mica superior in hardness to the surrounding mineral contain nodules of corundophyllite, which inclose a white corundum often streaked with a deep sapphire-blue; rare

J. H. Adams, October, 1870: Am. Jour. Sci., 2d series, Vol. XLIX, p. 271.

(The "corundophyllite" is biotite.)

1881. **Emery and iron.** West Worthington.

"Abram Granger's 50-acre pasture lot. Local geology," No. 2.

Chauncey Stephenson: Hampshire Gazette, November 29, 1881.

(The writer sent me some hornblende-schist as a sample of the emery.)

1885. **Emery.** Chester.

In veins in the magnetite showing the paragenesis—magnetite, corundophyllite, rutile, corundum, diaspore, calcite. The corundum occurs in flat blades partly white, partly deep blue, or rarely pink, which appear on dissolving the calcite and which at times are attenuated to blue threads running up into the calcite after the manner of graphic granite. The plates polarize in bright color and are very flat, distorted rhombohedra.

1886. **Corundum.** Hampden mine.

Report for 1880: Capital, real and personal, $310,000; total hands employed, 31 (1 boy, 11 men below ground); amount of wages, $9,347; boiler, 1; engine, 1; horsepower, 10; drainage machines, 2; hoisting machine, 1; fuel, cords of wood, 365; explosives, cost, $254; value of all materials, $4,572; product, tons, 600; value, $18,000.

Tenth Census, Vol. XV, 1886, p. 840.

1886. **Corundum.** Chester.

The finest piece of deep-blue massive corundum from the Chester mine is in the collection of the late Mr. Ames, of Chicopee. It is a large fragment from a vein 12 mm. in thickness.

1896. **Corundum.** Pelham.

Crystals 1 to 1½ inches across, 2 inches long; from colorless, with spots of deep blue, to complete deep-blue color; gray, granular masses as large as one's fist; crystals deep blue in tourmaline and in andesite, but more commonly in a thick band of deep bronzy biotite bordering olivine rock. So much has been found by Mr. B. F. Merrill, who has done much for the mineralogy of the locality, that many bags have been sold for crushing. The finest mass was 6 inches long by 3½ inches wide. It was a single crystal, but with rude outer faces and in cross section showed alternate hexagonal bands of rich blue and gray a half inch wide. It was penetrated by a crystal of allanite a half inch square and an inch long, and the corundum is puckered radially from the allanite for the space of an inch; so that when broken across it has a most remarkable fibrous radiated structure surrounding the broken end of the allanite crystal. The perfect glassy and lustrous cleavage surface of the corundum crystal is continued up to the border of the radiated fibrous or puckered area, and is within this area replaced by a small conchoidal, quartz-like fracture. The specimen is in the collection of Amherst College.

COTUNNITE.

1866. **Cotunnite**. Southampton lead mine.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 247.

(This is anglesite.)

CUMMINGTONITE.

1824. **Cummingtonite**. (Dewey.) Cummington.

See Amphibole.

1860. **Cummingtonite**. (Rammelsberg.) Cummington.

See Rhodonite.

The first use of the word for the ferruginous actinolite is now established.

CUPRITE.

1835. **Red oxide of copper**.

Mentioned as occurring in new red sandstone and trap, but no locality given.

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. XLVII, p. 323; Geol. Mass., p. 225.

1843. **Red oxide of copper**. Whately.

Coating specimen of native copper.

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. XLVII, p. 323.

1882. **Cuprite**. Deerfield.

In minute octahedra superficially altered into malachite; occurs on datolite in fissures of diabase.

B. K. Emerson: Deerfield dyke and its minerals; ibid., 2d series, Vol. XXXIV, p. 280.

CYANITE.

1818. **Cyanite or sappare**. Deerfield.

In mica-slate; discovered by Dr. S. W. Williams.

E. Hitchcock: Geol. of Conn. River; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1820. **Sappare**. Chesterfield.

Near line between Conway and Deerfield, a few miles east of the village of Conway.

A. Eaton: Index, p. 145.

1823. **Cyanite**. Chesterfield, Granville, Plainfield.

Chesterfield, in loose masses in mica-slate, where its bladed or imperfect prisms are 2 feet long (Hunt). Granville (Dewey), Plainfield (J. Porter).

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 219.

1823. **Kyanite**. Chester and Chesterfield.

Very dark, in mica-schist.

J. Porter: Loc. Min., ibid., p. 248.

1824. **Cyanite**. Chester or Norwich.

"A curious variety occurs here in very fine, soft mica-schist resembling potstone, often in hemitrope crystals; color grayish blue."

E. Emmons: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 254.

(The locality is uncertain, because he has mentioned Norwich in the sentence before and was writing from Chester. The description of the rock agrees best with Chester. I have, however, found the grey variety abundant in the sericite-schist just south of Chester.)

1824. **Cyanite**. Chester.

In common mica-schist. A darker variety than the common in dark mica-schist, generally in single prisms (Emmons). Blandford, Granville.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 40.

1825. **Cyanite**. Near Westfield.

Abundant to the north and west of the village of Westfield—the green and blue varieties; green in quartz and blue in mica-schist; blue not perfect crystals.

Emerson Davis: Min. Loc.; ibid., Vol. IX, p. 252.

(This refers to the towns mentioned above. The mineral does not occur in Westfield except along the west line.)

1825. **Kyanite**. Cummington.

Rare, large, well-defined crystals in mica-slate, with garnet, quartz, and black mica.

J. Porter: Min. Loc.; ibid., Vol. IX, p. 55.

1825. **Cyanite**. Conway, Chesterfield, Chester, Cummington, Blandford, Granville, Middlefield, Plainfield.

S. Robinson: Cat. Am. Min., p. 37, ff.

1827. **Cyanite**. Chesterfield.

Crystals azure-blue, 18 inches long, 2 to 3 inches broad.

A. Nash: Lead veins of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 241.

1828. **Sappare**. Chesterfield.

One mile north of meeting-house, on land of Mr. Searle. In veins in bowlders of mica-schist; doubtless is in place below; not good specimens now. Mr. Searle usually keeps a supply on hand to furnish travelers.

E. Hitchcock: Min. Loc.; Am. Jour. Sci., 1st series, Vol. XIV, p. 216.

1835. **Sappare**. Chesterfield, Blandford, Worthington, Middlefield, Deerfield.

E. Hitchcock: Geol. Mass., p. 345.

1835. **Rhœtizite**. Blandford and Russell (Emmons).

Ibid.

1844. **Kyanite**. (*Epimecius cyaneus.*) Chesterfield, Worthington, Blandford.

J. D. Dana: Sys. Min., p. 375.

1844. **Cyanite**. Chesterfield.

Analysis.

SiO_2	42.56
Al_2O_3	57.00
Loss	.44
	100.00

Same as fibrolite (Vanuxem).

F. Alger: Alger's Phillips Min., p. 108.

1866. **Kyanite**. Northfield. On Northfield Mountain, road to Erving.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

1877. **Cyanite**. Blandford, Russell.

North Blandford road, in hydromica-schist. South of Blandford Centre on West Granville road, between two brooks.

Russell, west of river on bank just below the old railroad bridge. Large crystals, gray, in schist; 100 by 25 mm.; fine blue in small segregated granite vein adjoining.

1882. **Cyanite.** Worthington.

On the old Rufus Smith farm, now owned by Spencer Stewart, 3 miles southwest of center. Also in ledge where Rev. Mr. P. W. Lyman has blasted it out, 40 rods southeast of R. Smith's house; also one-half mile west of this house in bowlders.

1882. **Cyanite.** Northfield.

Deep rich blue in single crystals and fibrous gray; top of gulf road, where it goes down to Erving.

W. E. Webster's collection, Northfield.

1883. **Cyanite.** Chester.

In fine large mass in bowlder about one-half mile southwest of Chester Center.

E. J. Whitaker, class of '83, Amherst College.

1890. **Cyanite.** Chesterfield.

"Cyanites were found in the early part of the century at Chesterfield, Mass., where some of the finest mineralogical specimens were obtained. An example of these, a mass measuring 10 by 6 inches, and consisting of distinct crystals over 3 inches long, piled one upon another, is in the British Museum at South Kensington, in London. The crystals are all distinct, of a fine blue color, and would cut into small mineralogical gems."

G. F. Kunz: Gems and precious stones of the U. S., p. 176.

CYMATOLITE.

MUSCOVITE-ALBITE PSEUDOMORPHS.

1825. **Talc.** Goshen.

With the rose mica occurs "a beautiful white talc, which I believe has not been credited to this locality."

E. Hitchcock: Am. Jour. Sci., Vol. IX, p. 21.

1867. **Cumatolite.** Goshen.

"Cumatolite (Kuma, Gr. a wave, from its undulating surface. H. =1.5. Gr. =2.74.) Occurs in long prismatic forms, seemingly the continuations of spodumene crystals, of which they constitute (at one end) about half the length. Cleavage micaceous in one direction, which is constantly intermediate between the two perfect prismatic cleavages of the contiguous spodumene. There is no blending of the two minerals, but simply a contact where the two crystals meet. Color white, luster pearly or that of satin. Thin laminæ transparent, inelastic. No appearance of having resulted from decomposition or metamorphosis of spodumene. Both minerals are perfectly fresh and lustrous throughout. Gives off no moisture or fluorine by heat. Before the blowpipe is nearly infusible except at the thinnest points, which only become rounded. Slowly dissolved by borax into a clear glass; with soda gives when cold an opaque white one. Cobalt produces an intense blue. No reaction of lithia, even when fused with bisulphate of potash. Scarcely attacked by acids. Fuses with carbonate of soda into a colorless mass, which gave about two-thirds silica, abundance of alumina, and not more than 1.5 per cent lime, with traces of magnesia. Neither potash nor soda were sought for. Found at the indicolite locality in Goshen, Mass.

"C. U. SHEPARD.

"AMHERST COLLEGE, *May 24, 1867.*"

C. U. Shepard: Private publication.

1867. **Cumatolite.** Goshen.

Correspondence with Prof. J. D. Dana, May 24, 1867; quoted in Dana's Sys. Min., p. 455.

1868. **Pihlite.** Goshen, Norwich.

Analysis by B. S. Burton. Cymatolite quoted as a synonym (Dana's Sys. Min., p. 455), with changed spelling.

"The locality (Norwich) is a mistake, as Professor Shepard says he found it only at the Barrus locality in Goshen."

A. A. Julien: Ann. N. Y. Acad. Sci., Vol. I, p. 327.

1871. **Cymatolite.** Chesterfield.

Analysis (imperfect and retracted) in the article "Spodumene and its alterations," p. 327; occurs in a quartzose segregation of a granite vein on a supposed new mineral from Chesterfield.

A. A. Julien: Am. Chem., Vol. I, p. 300.

1877. **Cymatolite.** Goshen.

Crystals 2 inches long in bluff north of Lily Pond.

1877. **Aglaite.** (A. A. Julien.) Chesterfield.

"A new mineral species with interesting relations to pihlite and cymatolite." Name proposed and analysis given the same as below, except that the water is given as 3.01, part of which is below assigned to organic matter.

A. A. Julien: Eng. and Min. Jour., Vol. XXIII, p. 217.

1879. **Cymatolite.** Goshen.

A preliminary notice in which the author restores the original name, cymatolite, but retains the name aglaite for the peculiarly brilliant and micaceous variety found at Goshen.

Analysis.

SiO_2	58.11
Al_2O_3	24.38
Fe_2O_3	1.66
MnO	.18
MgO	.75
CaO	.48
Li_2O	.09
Na_2O	2.57
K_2O	8.38
Organic matter	.43
(?)	2.58
	99.61

A. A. Julien: On the composition of the cymatolite from Goshen; Am. Jour. Sci., 3d series, Vol. XVII, p. 398.

(This small, micaceous variety found at Goshen was exactly the original cymatolite of Shepard.)

1879. **Cymatolite.** Goshen. Chesterfield.

Goshen; on the Manning farm; impure yellowish. On the Barrus farm, variety aglaite, always in continuation of (never as a crust on) the prisms of spodumene; with flat micaceous structure. At Chesterfield Hollow, Chesterfield, in crusts, often of large size, of fibrous micaceous structure, with wavy cleavage. A series of analyses of both the Goshen and Chesterfield mineral and a most elaborate discussion of its chemical formula are given; then a microscopical description follows. "The fibers of cymatolite seem to spring from those of the spodumene," or rather of the killinite, which latter seems to occupy the position of the β— spodumene of the next article by Brush and Dana. (See p. 346 of this article, and figures.)

A. A. Julien: Spodumene and its alterations; Ann. N. Y. Acad. Sci., Vol. I, p. 327.

1879. **Undetermined pseudomorph.** West Chesterfield.

Pseudomorphs after spodumene rather indistinct.

A. A. Julien: Spodumene and its alterations: Ann. N. Y. Acad. Sci., Vol. I, p. 349.

1879. **Albite after spodumene.**

This form, generally mixed with a little muscovite and less quartz, is a mere variety of the albitic granite below, and is rarer than the variety where muscovite prevails to the exclusion of the other constituents.

A. A. Julien: Ibid., p. 349.

1879. **Albitic granite after spodumene.**

The pseudomorphs, most conspicuous in size, even more so than those of cymatolite, consist of a vein granite made up of muscovite, albite, and quartz in varying proportions even within the same pseudomorph, with manganese, garnet, œrstedite, beryl, etc., occasionally interspersed.

The large cymatolite columns generally pass at one end into mixtures of this character, and enormous masses of 1 or 2 hundredweight have been formed. They consist of an aggregation of perhaps only two or three pseudomorphs of this kind, rudely, but in places distinctly, shaped, each from several inches to nearly a foot in diameter, and from 1 to nearly 3 feet in length. Various transitions were observed in the deposition of these materials, such as huge pseudomorphs of which a large core consisted of a coarse aggregate of mica crystals with an outer crust, one-half inch thick, of cymatolite; in other cases of grayish-white quartz.

The chemical explanation of this change seems to be: "A splitting up of two molecules of the bisilicate spodumene by a simple transference of two atoms of silica from one to the other into one molecule of muscovite and one of albite, the lithium being replaced by potassium or sodium out of the solution during this change. This may be represented: Two molecules spodumene, 1 molecule muscovite, 1 molecule albite, $R_4Al_4Si_8O_{24} = R_2Al_2Si_2O_8 + Na_2Al_2Si_6O_{16}$."

A. A. Julien: Ibid., p. 348.

1880. **Cymatolite.**

The supposed mineral is proved to be an intimate mixture of albite and muscovite. The spodumene changes into "β—spodumene," a pegmatitic mixture of albite and a new mineral, eucryptite, which latter has changed into muscovite. The cymatolite is thus a cryptocrystalline albitic granite.

G. J. Brush and E. S. Dana: The spodumene of Branchville; Am. Jour. Sci., 3d series, Vol. XX, p. 267.

1892. **Cymatolite.**

"The cymatolite from Goshen was earlier (Eng. Min. Jour., XXII, 217) called aglaite by Julien."

E. S. Dana: Min., 368.

(This should read "Chesterfield" for "Goshen," "XXIII" for "XXII," and "later" for "earlier" since cymatolite was published ten years earlier than aglaite.)

DAMOURITE.

See Muscovite, 1846.

DATOLITE.

1876. **Datholite.** Greenfield.

C. U. Shepard: Cat. of Min., within 75 miles of Amherst College, p. 4.

1882. **Datolite.** Deerfield.

The datolite is second only to prehnite in abundance at the new cutting, and surpasses all the minerals occurring here in beauty, perfectly pellucid crystals up to 12 mm. long being not uncommon, and many of the same showing a great range of rare faces and curious and perplexing distortions. It occurs also in thin veins, developing no crystals on the north side of the river and rarely in the amygdules in the light-gray diabase. The mineral fills the veins often completely with a white saccharoidal deposit from 10 to 50 mm. thick, with only here and there cavities in which fine crystals have come to development. It rests sometimes upon the trap itself, which is there quite fresh, and where slickensides occur they are of light-gray color, due to the mixture of datolite and trap, without the appearance of any of the chloritic or serpentinous products of decomposition which darken the same formation in the prehnite. More commonly it rests upon a thin layer of massive prehnite, rarely with several alternations of datolite and prehnite in calcite or upon the thick layers of spindle-shaped crystals of the former mineral, where the separate attached crystals reach the greatest perfection. The crystals of datolite, which resemble those of Farmington in their glassy clearness and general habit, are remarkable for the great number of faces represented and for the distinctness of the types into which they are grouped, as well as for the manifold and intricate forms produced by the unique development sometimes of single faces and sometimes of all the faces on one side of the vertical plane.

The following is a list of all the forms presented, arranged according to the table given by E. S. Dana[1]: *i*-*i* (*a*), *i*-ì (*b*), 0 (*c*), I (*M*), *i*-$\grave{2}$ (o), *i*-$\grave{3}$ (*l*), 1-*i* (*u*), — $\frac{4}{3}$-*i* (*v*),— (*x*),— (*s*), 4-*i*.(*Π*), 2-*i* (ξ), $\frac{1}{2}$-ì (*Ω*), 1-ì (*σ*), $\frac{1}{3}$-ì (*t*), 2-ì (*g*), 4-ì (*m*),— 4 (*n*), 2 (*ε*), $\frac{4}{3}$ (*λ*), 1 (*μ*), $\frac{2}{3}$ (*κ*), — 6-3 (*q*), — 4-2 (*ϑ*), 4-2 (*Θ*), 12-$\frac{3}{2}$ (*π*),— 16-$\grave{2}$ (R), — 8-$\grave{2}$ (*β*),—4-$\grave{2}$ (Q),— $\frac{2}{3}$-$\grave{2}$ (U),— 2-$\grave{2}$ (*γ*), 2-2 (*T*), $\frac{8}{3}$-$\grave{2}$ (*i*), 8-$\grave{2}$ (*B*), $\frac{8}{3}$-$\grave{2}$ (C), [new], $\frac{3}{2}$-$\grave{3}$ (E), $\frac{5}{2}$-$\grave{3}$ (F), $\frac{5}{2}$-$\grave{5}$ (K), $\frac{9}{4}$-$\grave{9}$ (G).[2]

For convenience of description the crystals may be divided into three types:

I. *The regular.* In this almost spherical forms are produced by the equal development of a large number of faces. In one crystal *x*, *ε*, *m* were slightly larger than the rest; *a*, M, *n*, *o*, *β*, Q, equally developed; *c*, *q*, B, very small.

Another very stout, prismatic and resembling the Andreasberg crystals somewhat in the distribution of its faces, except that the elongation in the direction of the clinodiagonal axis was only slight, had the faces *x*, *ε*, *λ*, *g*, *m*, largest; *ii*, M, — 4, *β*, Q, O, *μ*, *i*ì, about equal; *u*, *v*, *q*, *ϑ*, ξ, *o*, *π*, *a*, *x*, smaller.

A third was formed by the nearly equal development of *a*, *x*, *g*, *m*, *ε*, *λ*, *μ*, M, *o*, *n*, *β*, B, with O, *s* (— 6 *i*) *q*, and *γ* subordinate.

A fourth minute but very beautiful crystal was unique for this locality in having the face *o* large and square and *ii* elongated vertically, the faces *g*, *m*, *u*, *x*, *a*, *n*, M, *ε*, *λ* *o*, *β*, Q, U, *a*, about equally large, ξ, *q*, *μ*, *i*, F small.

Several of the larger crystals of this type showed a new face in the zone *λ* ($\frac{4}{3}$), *g* (2-*i*), and *o* (*i*-2), *c* (O) $\frac{8}{3}$-2, to which I have in the preceding list applied the letter C.

II. *Prismatic type.* By the great enlargement of *x* and two opposite faces of *m* a prism of 116° is formed, elongated in the direction of the axis of the zone *x*, *o*, *m*, the sharp edges of which are beveled by *n* and *o* elongated into narrow planes. The other planes are grouped in a very confusing

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[1] Tsch. Min. Mittheil., 1874, p. 5.

[2] This list has been corrected, as several misprints occurred in the original from lack of proof reading.

1882. **Datolite**—Continued.

way around the ends of this prism. The uniform dullness of the face *x* is a characteristic feature.

The crystal under this type which was richest in faces showed the following combination: *a, b, c,* M, *o, x, g, m, n, ε, λ, μ, q, β,* Q, U. B, *α, i*; another lacked the faces *b, k*, and those in the zone B, *o, β*. Other crystals showed the faces R, *π*, and *r* in traces.

III. *The tabular type*. The roughened faces of *x* are large and nearly circular and approached so as to reduce the crystal to a thick plate, around the edge of which the other faces are placed. The crystals of this type resemble closely the Haytorite pseudomorphs, some of them having the same faces in the same relative development as in the latter, others being even richer in forms than any I have seen described from the Haytor mine.

One crystal contained twenty-eight distinct forms, several only as fine lines, but all capable of quite close measurement. The crystal was peculiar in having the face *a* striated in two directions, forming a series of V's, as is common with the face *o* from other localities. The latter face is here finely polished.[1] The forms present were *a, c,* M, *o, u, ś, Π, ξ, Ω, σ, γ, m, n, ε, λ, μ, x, g, 0, β,* Q, U, *a*, B, E, F, K, G. Another crystal of this type went to the extreme of simplicity, being bounded by the faces *a, c,* M. *o, ξ, g, m, n, ε, λ, μ, q*, all quite large except *q* and O, and the face *ξ* unusually large and shield shaped.

Similar tabular forms have been recently described from the spheres of chalcedony from Theiss in Tyrol.[2]

Inclosures in datolite. Calcite. When the datolite is thrown in acid, much calcite is dissolved and a vesicular mass left; and similar pieces are found in the vein itself, showing that the same operation has been performed by natural agencies.

Selenite? Barite? In the thick veins the minerals are often abundantly gashed by the removal of broad, thin blades of some mineral, possibly selenite or barite, and the surfaces drused over by minute, very distorted crystals of datolite.

Axinite. Some of the finest crystals of axinite occur in the datolite. The crystals are here sometimes short, stout prisms.

Prehnite. Small portions of prehnite are inclosed rarely in the lower portion of the datolite; also small patches of the chloritic mineral identical with that derived from the decomposition of the former.

B. K. Emerson: The Deerfield dyke and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 352.

1882. **Botryolite.** Deerfield.

One cavity of the trap large and nearly globular, with vesicular walls, was filled with datolite, which was compact within the vesicles of the trap, but above was fine-granular, like loaf sugar, and much gashed, and at the surface coated with a layer of small botryoidal or globular botryolite, which would have been taken for hyalite if it had not proved fusible with green flame before the blowpipe.

Ibid., p. 355.

1888. **Datolite.** Deerfield.

Dr. O. Luedeke: Ueber Datolith, eine mineralogische Monographie; Zeit. für Naturwissenschaften, Vol. LXI, p. 235.

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[1] This striation was apparently parallel to the intersection edges which the face *a* produced would make with *o* and *i*-*i*.

[2] C. Vrba, Zeitsch. Kryst., Vol. V, p. 425.

1888. **Datolite**. Cheapside, north side of Deerfield River. Northampton.

In changing the location of the Fitchburg Railroad, a deep cutting was made in the Deerfield trap directly opposite the above locality and on the same sheet, separated only by the width of the river. Many large cavities of fine crystals were found. The locality differed markedly from the one on the other side of the river, as datolite was here the only mineral. The crystals were often larger than at the other locality, generally of the regular type and not quite so transparent, and showed a faint green tint.

DELESSITE.

See Diabantite.

DEWEYLITE.

1826. **Deweylite**. Middlefield.

Emmons: Man. Min. and Geol., p. 134.

1835. "**Deweylite?**"

In serpentine in Russell, on bank of Westfield River, one-half mile north of serpentine location in Westfield.

E. Hitchcock: Geol. Mass., p. 370.

This was probably the bastite from the Atwater quarry.

1835. **Kerolite**. Middlefield.

"The compact variety, deweylite (Emmons), at Middlefield in seams and irregular veins. Pseudomorphoses after quartz of considerable dimensions and of grayish-white color."

C. U. Shepard: Min., 1st edition, Part II, Vol. I, p. 292.

1841. **Deweylite**. Russell, Middlefield.

E. Hitchcock: Geol. Mass., p. 618.

1852. **Kerolite (Deweylite)**. Middlefield.

C. U. Shepard: Min., 3d ed., p. 146.

1876. **Deweylite**. Middlefield.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 3.

1883. **Deweylite**. Middlefield.

Under the microscope a delicate micro-botryoidal and laminated structure, wholly amorphous and winding in sheets among the remains of the serpentine, in which and from which it is formed.

DIABANTITE.

1818. **Green earth**. Deerfield.

Small quantity in amygdaloid.

E. Hitchcock: Geol. Deerfield dyke and its min.; Am. Jour. Sci., 1st series, Vol. I, p. 113.

1823. **Chlorite**. Deerfield, Greenfield, Gill.

In greenstone amygdaloid; it fills two-thirds of the cavities in some varieties of greenstone, and to the naked eye has a radiated aspect, but Professor Dewey remarks that it does not appear to be radiated under a magnifier, great or small, but to consist of folia curiously arranged, often with no regularity, their length somewhat greater than their breadth.

Green earth.—"A part of the chlorite described above appears to belong to this species."

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 28.

1826. **Radiated chlorite.**

With chlorophæite.

E. Hitchcock: Ibid., Vol. X, p. 393.

1841. **Chlorite.** Greenfield, Deerfield, South Hadley, Northampton, West Springfield.

"A dull-green foliated mineral, which appears to be chlorite. The folia have in general a radiated structure and sometimes invest calcareous spar. A little below Turners Falls, in Gill, just at the mouth of Fall River, on the east bank, is the best locality of this mineral with which I am acquainted. More frequently the cavities are occupied by earthy chlorite * * * along the east side of the ranges of greenstone."

E. Hitchcock: Geol. Mass., p. 660.

1876. **Delessite.** Greenfield (Turners Falls).

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 4.

1882. **Diabantite.** Turners Falls, Springfield.

The chloritic mineral, so uniformly and abundantly disseminated in the diabase of the valley, was entered in the catalogue of the State collection by Dr. Hitchcock as foliated chlorite, Turners Falls, and a paler pulverulent variety, as earthy chlorite, Springfield. That the mineral is chemically identical with that analyzed by Hawes, and named diabantite by him, is extremely probable in view of their identity in all physical and especially optical properties, and of the monotonous similarity of the many diabase dikes of the Connecticut basin, in which both occur. That the mineral is distinct from delessite, as the word is used by Zirkel, Rosenbusch, and Heddle, is much less certain.

It is the earliest product of the decomposition of the diabase, and proceeded doubtless from the alteration of the augite. In one case I found a mass having the shape of an augite crystal filled with magnetite toward the outside and polarizing as a single individual, but possessing the bright-green color and the strong dichroism of diabantite. It is disseminated in comparatively small amount through the mass of the rock between the feldspar crystals, and thus in the place of the augite, much more abundantly in the steam cavities and shrinkage cracks with which the rock abounds. It generally coated the empty amygdaloidal cavities first with a quite thick (½-1 mm.) foliated-radiated layer with minute, delicate botryoidal surface. Several such layers sometimes followed each other, and then the center became filled with a confused granular mass of the same material, the whole making a very pleasing effect under the microscope with its bright-green color and striking dichroism. Under crossed nicols this central granular portion often assumes a deep chlorite green studded with bright colorless spots (calcite?), and maintains this color through a whole revolution of the object, the bright spots being alternately extinguished. Sometimes, in the gray mottled diabase, a layer of magnetite was interposed between the layers of diabantite, and rarely large distinct crystals of magnetite appear wholly surrounded (in section) by diabantite, and in one case a fine large feather of magnetite projected into the diabantite. The long feldspar crystals, also, which border the cavity, often project freely into it and are then perfectly and more complexly terminated than when in the mass. The diabantite folds around and does not penetrate them. Often the center of the cavity is filled with calcite, impregnated with diabantite, so as to produce a pegmatitic appearance on cleavage faces, or with finely fibrous prehnite, and this also is for a greater or less distance toward the center blackened by the abundance of the diabantite which it has inclosed.

1882. **Diabantite**—Continued.

On the other hand, where over the botryoidal layer of diabantite there appear quartz, datolite, natrolite, sphalerite, or other sulphurets, they are entirely free from this impregnation. In the broad mineral-bearing fissures the diabantite often impregnates layers of scaly or fibrous prehnite 1 to 5 mm. thick over considerable surfaces so that a black or blackish-green mass results, often abundantly slickensided, which so resembles a very fine-grained scaly or fibrous schist that I supposed it to be formed by the pulverizing of the trap by friction and the cementing of the powder by prehnite, until the microscope made known its true character.

Farther north, on the dike opposite Turners Falls, the large flattened cavities are lined with a botryoidal layer, 1 mm. thick, of black-green diabantite, with crystals of chalcopyrite, blende, and albite upon it. The interior is very often filled with a dark olive-green fine-granular mixture of crystals of diabantite, which can be shaken out of the cavity as a fine powder, each grain of which appears, under the microscope, as beautifully vermicular as the helminth of the older rocks.

The paragenesis of the mineral is thus quite definitely fixed. It was the first product of the decomposition of the diabase, and its formation ceased not very long after calcite and prehnite began to be deposited in the cavities and fissures. As the formation of the latter minerals was attended by quite energetic decomposition of the trap, the formation of the diabantite, occurring still earlier, may well have been promoted by the increased chemical activity of the waters during the cooling of the trap after its solidification. The mineral seems to me plainly of secondary formation, and I can see no good ground for thinking that it was formed and deposited where we find it during the rise of the lava through the sandstones. The cavities flattened and fluidally arranged in the lower part of the mass, with well-terminated feldspars projecting into them, and growing very abundant and graduating into long vertically placed tubes in the upper portions, have certainly been formed by steam and can not have been filled till after solidification of the rock. This is much more certainly the case with the broad fissures that extend across the whole dike, which seem for a time to have furnished a passageway for boracic-acid springs, and in which the diabantite must have been formed much as were the calcite and prehnite that it has impregnated. The filling of the cavities also with several concentric and botryoidal layers, sometimes separated by calcite, would indicate slow deposition from water.

The great amount of protoxide of iron in the mineral does not seem to me to need for its explanation the assumption that it is an original constituent of the rock. The waters brought up in the lava, on becoming liquid, or the waters which reached the bed after percolating through the bituminous sandstones of the valley, may have been deprived of oxygen and able to exert strong solvent activity, without peroxidizing the iron of the augite. In discussing a mineral which seems to be identical with our diabantite and which forms the first coating of the amygdules of the phillipsite-bearing feldspar basalt of Salesl, Von Zepharovich[1] derives the same from sphærosiderite, the radiated and concentric structure and the botryoidal surface resembling in miniature that common in the carbonate. A cellular structure and traces of rhombohedral forms were also observed. I have seen here no traces of any such crystal forms. The cellular or excavated structure occurs frequently and can be produced in fresh specimens by acid, by the removal of calcite. The occurrence of the mineral in fresh prehnite and calcite would militate against its being here a pseudomorph after siderite.

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[1] Zeitsch. Kryst., Vol. V, 1880. p. 98.

1882. **Diabantite**—Continued.

Products of the decomposition of diabantite.—From its great content of ferrous oxide the mineral is very prone to decomposition, and in sections cut near the weathered surface of the rock its color has become red-brown, its strong dichroism is gone, and it shows only the faintest aggregate polarization. Sometimes a cavity shows the exterior changed and brown, the interior bright-green, with sharp lines of demarcation. In the large amygdules, masses of gold or bronze yellow, sometimes light straw-yellow, can be obtained, which exfoliate voluminously under the blowpipe, and then by a sharp explosion throw off the foliated portion and begin the operation anew. It is a *diabantite vermiculite*. At the end of this series of changes only a small quantity of limonite remains.

When a slide of the diabase is treated with hydrochloric acid, both the fresh and the altered diabantite are decomposed and white silica remains behind in plates having still the shape and arrangement of the original mineral. This is also the case with the vermiculite out of the crystalline rocks in Pelham.

Similar amygdules occur in the compact diabase, having a white color or being in part still green and dichroic, and having exactly the arrangement of the diabantite. These are silica, I have no doubt, and have been produced by some natural process analogous to the artificial one employed above. The white portions show marked aggregate polarization in white and black, but without bright colors.

B. K. Emerson: The Deerfield dyke and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 198.

DIALLAGE.

1823. **Diallage**. Conway? Granite.

E. Hitchcock: Geol. Conn.: Am. Jour. Sci., 1st series, Vol. VI, p. 227.

(This was possibly zoisite.)

1824. **Diallage**. Chester, Middlefield.

Chester, in diallage rock? Resembles metalloidal diallage.

Middlefield. In small quantity and small grain in serpentine.

C. Dewey: Geol. Berkshire County: Am. Jour. Sci., 1st series, Vol. VIII, p. 49.

(The first citation was probably a bronzy hornblende; the second, bastite.)

1868. See Enstatite.

1883. **Diallage**. Belchertown, Palmer.

In dark-green diallage granite, mostly changed to tonalite, in South Belchertown, and extending to Palmer.

Diallage with the usual brown-red inclusions as abundant and well characterized as in hypersthene from Pauls Island. Color green, fibrous; crystals just visible to the eye, then deep bronze like hypersthene, changing into a green fibrous uralitic hornblende, and this on the border into a scaly ring of bright-green chlorite.

DIALLOGITE.

See Rhodochrosite.

DIASPORE.

1865. **Diaspore**. Chester.

Needle-shaped crystals and blades on joints of emery blocks or sometimes embedded in compressed rounded masses quite within its substance; colorless, pink, violet: perfect crystals in open spaces.

C. U. Shepard: Report on Chester emery mine, p. 9.

1865. **Diaspore**. Chester.

With rose-colored amphodelite and with radiated epidote; distinct crystals and broad white laminæ.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, pp. 112. 123.

1866. **Diaspore**. Chester.

Analysis.

	No. 1.	No. 2.
H_2O	14.75	14.8
Al_2O_3	80.75	83.0
$FeO(TiO_2)$	4.50	....
$Fe_2O_3(TiO_2)$	....	3.0
	100.00	100.00

C. T. Jackson: Ibid., Vol. XLII, p. 107.

1870. **Diaspore**. Chester.

Fine crystal, semitransparent and of rich hair-brown color, with a faint tinge of violet; sp. gr. 3.343.

Analysis.

H_2O	15.80
PO_5	0.32
$FeO(MnO)$	0.38
Al_2O_3 (dif.)	83.50
	100.00

C. U. Shepard: Min. Contrib.; Am. Jour. Sci., 2d series, Vol. L, p. 96.

1886. **Diaspore**. Chester.

Commonly in thin cleavage planes implanted upon a magnetite gangue, occasionally in very delicate acicular crystals and again in groups of crystals tabular, parallel to the brachypinacoid. The crystals are in fact composite, consisting of parts in nearly parallel position. They are deeply striated in the vertical zone and also in the zone *p e*. The observed planes are *a* (100, $i\text{-}\bar{i}$), *b* (010, $i\text{-}\breve{i}$), *h* (210, $i\text{-}\bar{2}$), L (120, $i\text{-}\breve{2}$), *e* (011, $i\text{-}\breve{i}$), *s* (212, 1-2), *p* (111, 1), U (344, $1\text{-}\frac{4}{3}$), V (122, $1\text{-}\breve{2}$).

E. S. Dana: Am. Jour. Sci., 3d series, Vol. XXXII, p. 388.

1890. **Diaspore**.

The old vein has been reopened and a shaft 150 feet deep sunk from the hilltop to the main adit. Much diaspore struck in thicker veins and very broad sheets. Single cleavage surfaces 4 to 5 inches broad, 9 to 10 inches wide. Great masses of loosely interlaced blades of the finest color and luster, from rich peach-blossom color to deep pink. Also broad surfaces of magnetite covered with tabular crystals of a rich, smoky, amethystine color. The finest specimen, a surface nearly a foot square, is owned by Mr. N. A. Howard, director of the Hampden Quarry Company.

DILLNITE.

1876. **Dillnite**. Pelham.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 3.

(Probably the clay-like material from the entire decomposition of the biotite at the asbestos mine.)

DOLOMITE.

1818. **Bitter spar**. Loudville. Southampton lead mine.
Fine specimens.
A. Eaton: Southampton adit; Am. Jour. Sci., 1st series, Vol. I, p. 137.

1820. **Dolomite**. Middlefield (E. Emmons).
Professor Dewey: Am. Jour. Sci., 1st series, Vol. II, p. 236.

1822. **Brown spar**. Leverett.
In vein of galena (Hitchcock).
Cleaveland: Min., Vol. I, p. 183.

1823. **Brown spar**. Leverett.
In vein of galena, pyrite, copper, and blende; grouped in rhombic crystals on quartz, the lamellæ usually rounded.
E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 212.

1823. **Rhomb spar**. **Dolomite**. Southampton, Middlefield.
Ibid.

1824. **Dolomite**. Middlefield.
In steatite; some fine white close-grained; others show cleavage distinctly; others yellowish-brown, high pearly luster, translucent; also in west of town with tremolite.
C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 34.

1824. **Rhomb spar**. Middlefield.
E. Emmons: Loc. Min.; ibid., Vol. VII, p. 255.

1824. **Brown spar**. West Springfield.
With amethyst; found by Mr. Alonzo Chapin.
C. U. Shepard: Min. Loc.; ibid., Vol. VIII, p. 235.

1825. **Rhomb spar**. Southampton.
In veins of galena.
Robinson's Cat., p. 70.

1826. **Rhomb spar**. Cummington.
Well crystallized in steatite.
J. Porter: Min. Loc.; ibid., Vol. X, p. 18.

1835. **Bitter spar**. Middlefield.
Masses 3 to 4 inches across in delicate green talc, white or salmon-colored.
E. Hitchcock: Geol. Mass., p. 362.

1835. **Ankerite**. In West Springfield, in connection with the coal formation.
C. U. Shepard: Min., Part II, Vol. I, p. 25.

1835. **Brown spar**. Leverett; north mine.
Few crystals.
E. Hitchcock: Geol. Mass., p. 502.

1841. **Brown spar**. Leverett.
E. Hitchcock: Geol. Mass., p. 101.

1841. **Bitter spar**. Middlefield.
E. Hitchcock: Geol. Mass., p. 700.

1841. **Miascite**. Zoar.
Columnar variety of dolomite; in talcose schist.
Ibid.

1844. **Breunnerite.** Ibid.

Suggests that the rhombohedral crystals in steatite in Middlefield are of this species.

F. Alger: Alger's Phillips Min., p. 297.

1866. **Dolomite.** Chester.

In some veins with sapphire at Chester emery mine.

C. T. Jackson: Proc. Bost. Soc. Nat. Hist., Vol. XI, p. 32.

1876. **Ankerite.** West Springfield.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 2.

(The coal formation mentioned above (1835) is, of course, the dark Triassic shale, and the citation seems to be the same as that given by Professor Shepard, 1825, of brown spar with amethyst. This would make the locality to be the trap, as no amethyst has been found in the shales. I have found only calcite and siderite in the shale and trap of this region.)

1890. **Dolomite.**

Dolomite in fine cleavage specimens, associated with green talc, can be obtained at all the serpentine beds, especially at Middlefield and Rowe.

All the crystals I have seen from the lead mines have been calcite and not dolomite.

1895. **Dolomite.** Chester.

In running the adits in the talc bordering the emery vein fine, large specimens of dolomite have been obtained. They were large, white rhombohedra.

ENSTATITE.

1826. **Petalite** (?). Westfield, 5 miles west of Academy.

Unknown mineral suspected to be petalite; sp. gr. 23–25; scratches glass; fine foliated; melts to enamel with difficulty; no effervescence; in places rose red or purple; in 1-inch layers in serpentine; no lithia, but lime and magnesia.

E. Davis: Rocks and minerals of Westfield, and appendix; ibid., Vol. X, p. 213.

(This is the enstatite from the Munns Brook locality on the line between Southwick and Granville or from bowlders of the same farther north.)

1835. **Scapolite.** Westfield.

Compact.

C. U. Shepard: Min., Part II, Vol. II, p. 175.

1841. **Scapolite** or **Petalite.** Westfield.

In serpentine in Westfield in vein nearly 1 foot wide.

Ibid., p. 618.

1841. **Anthophyllite.** Westfield.

"Also a mineral which I am disposed to refer to anthophyllite."

E. Hitchcock: Geol. Mass., p. 618.

1868. **Diallage.** Westfield and Blandford in serpentine.

J. D. Dana: Sys. Min., p. 220.

(The Westfield citation is plainly the above; that from Blandford I suppose to be Shepard's "anthophyllite," which I have referred to actinolite.)

1889. **Enstatite.** Granville.

The coarse enstatite rock of Munns Brook, Atwater's quarry, and Westfield River is described in the monograph on the region, and the large crystals of enstatite, superficially altered to bastite and talc, which occur in bowlders at the cemetery in Granville and just north in the great

1889. **Enstatite**—Continued.
ledge in the swamp east of J. Downey's and also south of J. M. Cooley's in the northeast of Granville, where crystals 6 inches long can be obtained. are fully discussed.

1893. **Diallage.** Westfield and Blandford in serpentine.
C. Hinze: Min., p. 1091.

EPIDOTE.

1818. **Epidote.** Deerfield, Shutesbury, Leyden, Pelham (poor).
E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I. p. 114.

1823. **Epidote.**
Tolland (Webster); Shutesbury, small crystals in gneiss. In many other places not very interesting. Shelburne, arenaceous. East Shutesbury, Leyden, Shelburne, Buckland, Whately, Belchertown, Monson, in hornblende and greenstone slate.
E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 223.

1824. **Epidote.** Pelham.
C. U. Shepard: Min. Loc.; ibid., Vol. VIII, p. 235.

1824. **Epidote.** Worthington, upon hornblende rocks; Middlefield, Chester.
C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 44.

1825. **Epidote.** Belchertown.
In greenstone (Eaton).
Robinson's Cat. Min., p. 36.

1825. **Epidote.** Plainfield, crystallized or granular. Williamsburg, in quartz, remarkably beautiful.
J. Porter: Min. Loc.; Am. Jour. Sci., 1st series, Vol. IX, p. 54.

1827. **Epidote.** Williamsburg.
In quartz in layers, with small garnets as a focus, around which the epidote is radiated.
A. Nash: Lead mines of Hampshire County; ibid., Vol. XII, p. 259.

1835. **Epidote.** Williamsburg, Middlefield, Chester, Cummington, Worthington, Plainfield.
In mica-slate embedded in quartz with hornblende.
E. Hitchcock: Geol. Mass., p. 346; Geol. Mass., 1841, p. 606.

1841. **Epidote.** Pelham, with schorl in gneiss.
E. Hitchcock: Geol. Mass., p. 637.

1844. **Epidote.** (*Carbunculus rhomboideus.*) Rowe.
In hornblende slate.
J. D. Dana: Sys. Min., p. 379.

1865. **Epidote.** Chester emery vein.
Frequent, especially in the vein on both sides the smaller Deerfield River; light yellowish-green; 1 to 2 inches long by one-eighth to one-fifth inch wide, with margarite; also radiated pistachio-green with diaspore on cross joints of vein rock.
C. U. Shepard: Report Chester emery mine, p. 11.

1866. **Epidote.** Northfield; on Northfield Mountain.
C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.
(Only unimportant traces of epidote were found by me during a careful survey of Northfield Mountain, and the best local mineralogists know of no important locality there.)

1882. **Epidote.** Pelham. Ward's quarry, in gneiss.

In elongated, flattened, and striated blades and sheaf-like aggregations of blades, blackish-green at one end and pistachio-green at the other.

1882. **Epidote.** Deerfield.

"Occurs rarely low down in the prehnite; more commonly in drusy surfaces in its upper part, or spread in delicate tufts of flat blades upon the spindle-shaped crystals. It is included also with interrupted crystallization in the calcite which follows upon the prehnite. The maximum size of the crystals is 3 mm. They are mostly thick plates, and under the microscope show as brilliant luster and as rich dark-green as the specimens from the Dauphiny. It incloses as an aggregate prehnite, sphalerite, chalcopyrite, and calcite, but the separate crystals are perfectly pure and transparent. The thickest crystals are deep pistachio-green; the thin plates are deep brown-red, sometimes half colorless."

B. K. Emerson: Deerfield dyke and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 350.

1883. **Epidote.** Pelham; Gaylord's pasture.

In fragments of large bowlder west of the west serpentine knob, 1 mile south of red house; the bowlder made up wholly of epidote and calcite; quite good crystals an inch long; twins. Most of the epidote crystals in collections from Pelham are from this locality. The beautiful slickensided surfaces of light-green polished epidote come from the gneiss in the west of Pelham.

1885. **Epidote.** Rowe.

Curved, thick, columnar forms in pyrite in J. M. Davis & Co.'s mine.

Analysis.

SiO_2	38.20
Al_2O_3	24.62
Fe_2O_3	12.20
MnO	.57
MgO	.13
CaO	21.59
Alk	.37
H_2O	2.16
Res	35.00
	[1] 100.19

A. G. Dana: Gahnite of Rowe; Am. Jour. Sci., 3d series, Vol. XXIX, p. 456.

1892. **Epidote.** Rowe.

In the pyrite mine with gahnite.

E. S. Dana: Min., p. 520.

1885. **Epidote.** Chester, Worthington, Hawley, Warwick, Huntington.

Chester. On a flat fissure surface of the emery an acicular-radiate growth, the blades being 5 cm. long and of a fine light pistachio-green. Also beautiful elongate-bladed crystals of deeper color on granular chlorite. The finest specimens are in the collection of Mr. Ames, of Chicopee.

Worthington. Below Cushing's gate, 1 mile west of Center. Fine crystals occur in the chlorite schist of the Hawley series.

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[1] Two analyses.

1885. **Epidote**—Continued.

Hawley. M. V. Cressey's farm. Large bowlders full of large interlaced blades, often much warped of deep-green epidote in sericite-schist of the Hawley series.

Warwick. Crystal hill. On the blind road running south from the village to Hastings pond. Great masses of a rock consisting of massive epidote of rich pistachio-green and deep-red garnet, associated with hornblende schist. Drusy surfaces of very dark epidote crystals of complex form occur.

Huntington. A half mile south of the East Branch. From a calcareous layer in the Conway schist, associated with coarse biotite. Pearl-gray crystals which strongly suggest zoisite. I found the angles of epidote by many measurements. Fine crystals nearly an inch across and two inches long, elongated in the direction of *b* and twinned, with the twinning plane *a* often multiple twinned. From the rarity of the color these crystals have sold for high prices.

EUCHLORITE.

1876. **Euchlorite.**

See Biotite.

EUMANITE.

1851. **Eumanite.** Shepard. Chesterfield.

Only a single minute crystal less than a grain in weight is known. Described and figured.

Editor's note (J. D. Dana?): Remarks the crystallographical similarity with topaz.

Mineralogical notices: Mineral species described by Prof. C. U. Shepard; Proc. Am. Assoc. Adv. Sci., Vol. IV, p. 317; Am. Jour. Sci., 2d series, Vol. XII, p. 211.

1851. **Eumanite.** Chesterfield.

"A few days since I received for examination from Mr. J. E. Teschemacher two minute crystals of the eumanite of Professor Shepard. They had long been in his cabinet.

"Eumanite and brookite are very closely similar, not only in physical characters, but also in crystallization."

J. D. Dana: On the crystallographic identity of eumanite and brookite; Am. Jour. Sci., 2d series, Vol. XII, p. 397.

1852. **Eumanite.** Chesterfield.

J. E. Teschemacher: On the angles of eumanite; Am. Jour. Sci., 2d series, Vol. XIII, p. 117.

1852. **Eumanite.** Chesterfield.

Description and figure. It appears to approach mengite.

C. U. Shepard: Min., 3d ed., p. 285.

1868. **Brookite.** (?) **Eumanite** (Shepard). Chesterfield.

Its chemical identity with brookite has not been ascertained.

Dana: Min., p. 165.

1876. **Brookite. Eumanite.**

Omitted, probably by oversight.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst.

1892. **Eumanite.**

Made to follow brookite as an imperfectly known species.

E. S. Dana: Sys. Min., p. 243.

The crystals upon which the species was founded were burned with the Shepard collection. As the mineral was not found by Julien in his exhaustive study of the tourmaline-bearing veins, the final determination of the mineral will probably be long delayed.

FASCICULITE.

1823. **Fasciculite.** (Hitchcock. See Amphibole.)

This form of hornblende is so widely spread and characteristic in the Hawley schists that I have frequently used the word as a variety name in the geological discussion of the region.

FIBROLITE.

See Sillimanite.

FLUORITE.

1810. **Fluat of lime.** Loudville.

First pointed out as such by Dr. Bruce, who has recently visited the spot. The prevailing color is green, but there are spots of purple and blue; the structure is lamellar; the green pieces are translucent, and a few cubical crystals occur.

B. Silliman: Bruce's Jour., Vol. I, p. 68.

1822. **Fluate of lime.** Deerfield.

Dr. Cooley has discovered in Deerfield fluate of lime, crystallized, I believe, in dodecahedrons, though I could not determine this certainly, as I had no glass when I examined them.

Letter of E. Hitchcock: Am. Jour. Sci., 1st series, Vol. V, p. 407.

1822. **Fluorite.** Near Northampton.

Dr. David Hunt: Editor's note; ibid., Vol. VI, p. 188.

1823. **Fluate of lime.** Conway. Loudville. Deerfield.

Conway. Massive, light green; in small quantities in a vein in mica-slate. Loudville (Gibbs). Deerfield; in a loose stone with galena.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 212.

1841. **Fluor spar.** Conway. Loudville.

Green and purple. Hollow pseudomorphs in quartz cubes, drusy within and without.

E. Hitchcock: Geol. Mass., pp. 701-702.

1858. **Fluor spar.** West Springfield.

Purple, incrusting Triassic bituminous limestone.

E. Hitchcock: Cat. State collection; Rep. State Board Agri., p. xx.

1882. **Fluorite.** Northfield.

Purple; in fissures in quartzite in Ross's lead mine. Winchester line, Perchee Brook.

1882. **Fluorite.** Deerfield.

"Emerald-green dodecahedra, like beads strung upon a satin thread, occur half embedded in and scattered over and among the last-formed fibrous prehnite, the crystals 0.03 mm. in length; also in the same relation to epidote and inclosed in the calcite which succeeds these. In a single case each emerald-green octahedra and cubo-octahedro, 0.03 mm. in size, in a drusy cavity in epidote and in green cubes upon prehnite."

B. K. Emerson: Deerfield dyke and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 350.

1886. **Fluorite.**

Northampton. Quarry south of W. N. Moore's, east of Florence.

In minute colorless cubes incrusting calcite, and in hollow quartz pseudomorphs after the same.

Hatfield. At lead mine. In small quantity on barite; purple.

Hawley. At the southern openings on the hematite vein; white cubes, 8 mm. across.

GAHNITE.

1885. **Gahnite.** Rowe.

In pyrite, at the mines of J. M. Davis & Co.

In outer portion of pyrite mass; greenish; up to three-fourths of an inch in size; O, ∞ O, twins.

Analysis.

Al_2O_3	54.83
Fe_2O_3	3.00
FeO	3.37
MnO	Trace.
MgO	1.93
ZnO	36.92
SiO_2	.53
	[1] 100.58

A. G. Dana: On the gahnite of Rowe; Am. Jour. Sci., 3d series, Vol. XXIX, p. 455.

1888. **Gahnite.**

Analysis.

Al_2O_3 and Fe_2O_3	58.05
ZnO	35.90
Insoluble	1.49
	95.54

Gahnite or zinc spinel from Rowe, Mass., W. O. Crosby and C. L. Brown. Tech. Quarterly, Vol. I, p. 407.

GALENA.

1810. **Galena.** Southampton lead mine.

"Both of the broad foliated kind commonly called potters' lead ore, and of the small foliated kind usually denominated steel-grained ore; masses from a fraction of an inch to more than a foot in diameter; very pure and rich. Sometimes beautifully crystallized in cubes with blende on quartz; affords 50 to 60 per cent of lead, 12½ ounces per ton, silver."

B. Silliman: Bruce's Jour., Vol. I, p. 65.

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[1] Mean of two analyses.

1818. **Galena.** Whately, Montgomery, Southampton, Hatfield.

Single crystals not in place in Greenfield.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 115.

1818. **Sulphuret of lead.** Southampton.

The fairest cubic crystals are slightly attached to the points of the quartz crystals. Found 774 feet from the mouth of the adit.

Amos Eaton: Southampton adit; ibid., p. 136.

1827. **Galena.**

Leverett. One mile northwest of meetinghouse, 1½ miles south of the first locality; in granite. Hatfield, 1 or 2 miles west of village, in syenite. Williamsburg, east part; granite, runs into Whately; one-half mile west of above, in granite. Whately, southwest part, in granite; on north line, in granite. Conway, east part, in granite. Williamsburg, northeast part, bowlders of granite. Goshen, 60 rods west of church, in mica slate. Northampton, southwest part. Southampton. Loudville, and 3 or 4 miles south.

A. Nash: Lead mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 249.

1835. **Galena.** In fetid limestone in West Springfield, at Paine's quarry.

E. Hitchcock: Geol. Mass., p. 230.

1838. **Galena.** Russell. Farm of John Gould. Norwich, farm of Quartus Angell.

E. Hitchcock: Econ. Geol., p. 127.

1841. **Galena.** Fourteen veins in vicinity of Connecticut River.

Adds nothing to preceding citations.

E. Hitchcock: Geol. Mass., final report, p. 199.

1844. **Galena.** (*Plumbites cubicus.*) Southampton. Leverett.

J. D. Dana: Sys. Min., p. 497.

1882. **Galenite.** Deerfield.

Extremely rare in minute grains in prehnite, chlorophæite, and calcite; in veins in diabase.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 351.

1883. **Galena.** Leverett.

East mine, in fine small cubes.

Whitaker, class of '83, Amherst College.

1895. **Galena.** Southampton lead mine.

Pseudomorph in quartz. Hollow cubes, with thin plates on the interior, which have penetrated the cubical cleavage of the galena.

GARNET.

1818. **Garnet.** Conway, Deerfield, Shelburne.

Melanite. Conway.

E. Hitchcock: Geology of Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

In a supplement it is said that above is probably not melanite; ibid., p. 439.

1822. **Garnet.** Plainfield.

Mass as large as one's head entirely composed of garnets one-fourth inch diameter in hyaline quartz.

Dr. J. Porter: Editor's note; Am. Jour. Sci., 1st series, Vol. IV, p. 55.

1823. **Garnet.** Tolland, Plainfield, Chesterfield, Conway, Deerfield, Brimfield.

Tolland; nearly rose red (Webster). Plainfield, in limpid quartz, trapezohedrons black (J. Porter); in talcomicaceous slate, dodecahedrons brown-red, one-third inch in diameter, dodecahedrons with truncated edges, dull-red, two-fifths inch; also in dodecahedrons 2 inches in diameter in talcose slate. Chesterfield, with sappare, trapezohedrons, light rose-red. Conway and Deerfield, in hornblende and mica-slate, black dodecahedrons.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 222.

1823. **Pyrope.** Brimfield.

In granite, with light-green feldspar in rounded irregular masses of a delicate poppy red, much resembling some varieties of the ruby. "It scratches crystallized quartz," says Professor Dewey, "and melts rather hardly into a dark enamel; found in digging a well."

E. Hitchcock: Loc. cit.

1823. **Colophonite.** At Conway?

E. Hitchcock: Loc. cit., p. 222.

1824. **Garnet.** Hawley, Middlefield, Chester.

Hawley; large dodecahedrons. Middlefield; dodecahedrons, trapezohedrons, and the same with truncated edges.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 44.

1824. **Melanite.** Chester; in hornblende.

C. Dewey: Ibid.

1825. **Melanite.** Conway; in mica-slate.

Eaton: Index, p. 145; Robinson's Cat., p. 44.

1826. **Garnet.** Chesterfield.

Some rocks of reddish-brown hornblende contain an immense number of garnets from the size of a shot up to that of a small cannon ball. These rocks are situated a mile northeast of the meetinghouse, near the celebrated locality of cyanite.

J. Porter: Min. Not.; Am. Jour. Sci., Vol. IX, p. 18.

(This is the garnet-cummingtonite rock.)

1835. **Garnets.** Brimfield, Wales, Ware.

Very delicate garnets in Brimfield, in gneiss; also less fine in Wales and Ware.

E. Hitchcock: Geol. Mass., p. 398.

1841. **Garnet.** Westfield.

Massive in serpentine. Also summary of above citations.

E. Hitchcock: Geol. Mass., pp. 188, 606, 618.

1844. **Garnet.** (*Carbunculus dodecahedrus.*) Brimfield, Chesterfield, Cummington.

J. D. Dana: Sys. Min., p. 382.

1866. **Garnet.** Northfield, on Northfield Mountain.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

1886. **Garnet.** Northfield.

Fine deep-red garnets, almost suitable for cutting, occur in immense numbers on old Chapin farm on Northfield Mountain, five minutes' walk east of black lead mine; crystals nearly an inch across, 2O2 with striated faces, ∞ O.

1887. Garnet. Davis mine, Rowe.

Red-brown, 6 to 8 mm. across, ∞ O. Broad surface of pyrite and garnet, making attractive specimens.

1894. Garnet. Almandite. Goshen, etc.

The garnet characteristic of the Goshen and Conway schists, which has often been called melanite, is a common iron alumina garnet.

The crystals have a curious and beautiful structure when seen in thin section. Commencing at the center, six radial bands of quartz grains extend outward in the clear material, and the latter becomes gradually clouded with a very fine dust, which increases to a maximum, and a clear band follows with beautiful bastion-like outgrowths at the corners. (See fig. 1, showing garnet with quartz enclosures and clear rim from secondary enlargement, from Conway schist, Hawk's quarry, Goshen.)

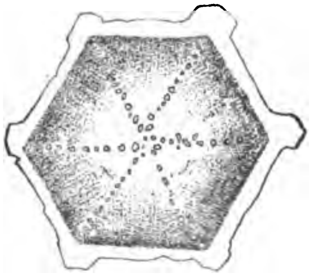

Fig. 1.—Garnet with quartz inclosures.

An analysis was made by Mr. George Steiger, of the United States Geological Survey, of material selected from a typical specimen of the Conway schist coarsely spangled with transverse biotites from the northwestern part of Goshen.

Analysis.

SiO_2	37.30
TiO_2	.24
Al_2O_3	21.84
Fe_2O_3	.98
FeO	32.62
MnO	1.86
CaO	3.19
MgO	2.50
	100.53

1894. Garnet. Warwick.

On south road to Warwick, at last house but one before reaching town line; crystals quite good and abundant in mica-schist, ∞ O, 2 O 2, 9 mm. in diameter. Also on North Mountain, three-fourths mile east of Horace Sykes's; crystals deep-red and of perfect form, ∞ O, 2 O 2, 25 mm. in diameter.

Warwick, at D. Bacon's, northwest of town, ∞ O up to 10 mm.; fine crystals in mica-schist.

1894. Garnet.

Chester, at the "quartz mine" in the extreme east of the town, 2 O 2; 30 mm. in diameter, fine dark-red near center; large and fine, like the **Russell crystals.**

1894. **Garnet.** Russell.

One mile south of Thorp's, now Pomeroy's, the first house on the river road coming from Westfield, perfect forms 2 O 2, abundant and very large black almandine garnets from a granite vein. This locality has been largely worked by Mr. Daniel Clark and by a Mr. Johnson, of Tyringham, and specimens from this locality, most ingeniously fabricated, have been offered for sale as coming from Tyringham. Many hundred dollars' worth were obtained from the locality, which is now exhausted. They have been also cited as coming from Westfield.

1894. **Garnet.**

Huntington, 2 O 2 in granite, 75 mm. across.

1895. **Garnet.** Northfield.

C. A. Ware's pasture, Gulf road; bowlder of coarse muscovite granite. Red almandine garnets with exceptional dodecahedral cleavage, of the form 2 O 2, three-fourths inch across, with a kelyphite-like rim three-sixteenths inch wide, but with irregular outer border, which is opaque white, but appears finely plumose with a lens. A narrow dark-green border can be seen to separate the white rim from the garnet.

Under the microscope the garnet is seen to have a very irregular surface, and a layer of zoisite and hematite fits into all the irregularities and builds out quite perfect crystal faces for the garnet. The hematite is in parallel bands in distant partings in the zoisite, and round blebs of this are inclosed with quartz grains in the clear garnet.

Outside this is a second thin layer of a green chlorite, and the series is closed by a broad and beautifully plumose and tufted growth of fibrolite in the finest fibers, which grows out into the feldspar and quartz of the surrounding granite.

GEDRITE.

1892. **Gedrite.** (Aluminous anthophyllite.) Warwick.

On the hill 20 rods south of Harris's soapstone quarry. A very coarse, granular, rich hair-brown rock. The separate plates show fine cleavage parallel to the prism and pinacoids. Under the microscope a part of the color is found to be due to the deep red-brown rutile grains and rods, which often are geniculate crystals.

The mineral shows moderate pleochroism; *a* almost colorless; *b* clove brown; *c* pale clove brown. Transverse sections, showing strong cleavage of 124°, gave the ring system symmetrical to *c* and the plane of the optical axes parallel to *b*. It is optically negative.

Delicate needles, long and rigidly straight and parallel, occur now and then in some number parallel to *c* and *b*. The mineral is very fresh, and will furnish fine cabinet specimens in great quantity. The large soapstone deposit to the north is formed by its decomposition.

The following analysis (I) was made with very fresh material, separated by heavy solution, in the laboratory of the Survey, by Mr. E. A. Schneider. II was of the average rock, by L. G. Eakins.

	I.	II.		I.	II.
SiO_2	47.86	50.65	K_2O	.06	.04
TiO_2*	.63	.50	Na_2O	.93	1.37
Al_2O_3	14.09	13.03	H_2O (105°)	None.	
Cr_2O_3		Trace.	H_2O (above 105°)	2.46	†2.96
Fe_2O_3	.33	.27	P_2O_5	.05	Trace.
FeO	13.41	12.67	B_2O_3		
MnO	.14	.15			
MgO	10.89	16.96		100.42	100.33
CaO	.57	1.73			

* Total 7; O_2 in the form of rutile. † Direct determination.

GOETHITE.

1852. **Goethite.** Greenfield, near Turners Falls.

In powdery scales along with the chalcopyrite in a thin vein at the junction of the sandstone and trap.

C. U. Shepard: Min., p. 278.

GOLD.

1833. **Gold.**

E. Hitchcock: Geol. Mass.; Am. Jour. Sci., 1st series, Vol. XXII, p. 65; Separate publication, Amherst, Mass., p. 65.

The probability of finding gold in the sericite-schist is fully discussed and an account is given of its being found in his presence at Somerset, Vt., just over the State line; twenty or thirty pieces, in weight 7 grains. He indicates the neighborhood of the Hawley iron mine or the Plainfield manganese bed or the bed of the Deerfield River, in Monroe, or Charlemont, as probable localities.

1841. **Gold.**

I have received many reports of the washing of gold in the western hills, but have never seen any derived from any portion of the three river counties, nor does President Hitchcock seem to have been more fortunate. He gives a long list of foolish attempts to find the precious metal.

Geol. Mass., 1841, p. 612.

1879. **Gold.** Chester.

"Specimens of gold and silver are said to have been found" in Chester. Hist. Conn. Valley, Vol. II, p. 1054.

1886. **Gold.** West Worthington.

[From the Hampshire Gazette, February 22, 1886.]

WEST WORTHINGTON, *January 25, 1886.*

To the Editor of the Hampshire Gazette:

Prof. Edward Hitchcock, a former president of Amherst, was an eminent geologist, as is very well known from his different works on the science, and he was many years ago employed to make a geological survey and report of the State of Massachusetts. He found the lone, long, narrow streak of talcose slate formation, but did not stop, it seems, to look it over carefully to see what it contained. He left that for others to do.

I will premise "that these talcose rocks are to a great extent the gold rocks of the world, especially the quartz veins therein." So states Professor Dana in his Mineralogy. The comparatively narrow strip of talcose slate ledge starts at the south end including Chester, extends north to Vermont State line in the town of Heath, where they are now mining for gold and copper. In my present brief description of this strip of talcose ledge, I shall confine myself to the two ends of a section about 3 miles in length, running in a north and south direction, in the towns of Worthington and Peru.

First, at the south end, on the farm of Austin Geer, of West Worthington, are two large quartz veins, one white and the other yellow in color. They run parallel with each other, about 20 rods apart. They crop out of the slate rock, 6 rods in length each, and will average about 2 feet in width. These two veins are thickly filled from the surface down with very beautiful, shining crystallized sulphurets of various-sized cubes of gold, silver, and manganese, or alabandine. Native gold, or a nugget as large as a common-sized pea, has also been found here.

1886. **Gold**—Continued.

Second, at the north end of this limited strip of slate ledge, on the farm of Wesley Pierce, of Peru, occurs a very remarkable open surface bed of rich gold and silver, that has yielded, from fair crucible tests, over $100 to the ton of ore, of both gold and silver.

CHAUNCEY STEPHENSON.

The above letter is copied as an illustration of the basis upon which mining work is still often done in Massachusetts. It is not probable that the writer obtained anything from the region excepting pyrite.

1887. **Gold**. Buckland.

"Gold mine" at house of H. W. Dodge. A thin pyritous hornblende bed in the Conway schist.

I copy the following remarkable papers as another illustration of the manner in which people are still led to waste money on the foolish search for gold:

[W. French Smith, Ph. D. (consultation), State assayer and analyst for Massachusetts; A. B. Brown, assayer and analyst. Certificate of analysis, 7509.]

In 2,000 pounds.

0.25 ounce Troy gold, at $20.67	$5.17
1.14 ounces Troy silver, at $1	1.14
0.00 ounce Troy copper, at 11 cents	0.00
5 ounces Troy lead, at 5 cents	.25
	6.56

January 6, 1887. 235 Washington street, Boston.

[Established 1853. Gold and Silver Refining and Smelting Works of L. B. Darling, Providence, R. I.]

THEODORE WOOD, Esq.,
Shelburne Falls, Mass.

DEAR SIR: The specimens of rock sent me by express give good indications outwardly of containing gold and silver. I have assayed many speciments [sic!] giving less indications and yet good results in the precious metals. The costs of assaying and giving you the real results in value per ton will be $3.

Yours, truly, L. B. DARLING.

MARCH 2, 1887.

[Assay 4218. Drab slaty mineral with iron pyrites.]

Gold per ton, 1 ounce; silver per ton, 2¼ ounces; value, $23.90.

[Assay 4564. Dark-blue slate rock with pyrites of iron.]

Gold per 2,000 pounds, four-tenths ounce; silver per 2,000 pounds, one-fifth ounce; value, $8.44.

L. B. DARLING.

A button of the gold obtained from this mine was said to be on exhibition at Mr. Henry Swan's, in Shelburne. It would be hard to find a ledge in the region which showed any less "indications" of gold.

GRAPHITE.

1820. **Plumbago**. Brimfield.

In granite and gneiss.

A. Eaton: Index, p. 94.

1823. **Plumbago.** Cummington, Worthington, Chester.

Foliated.

J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VI, p. 248.

1826. **Graphite.** Same.

Ibid., Vol. X, p. 18.

1835. **Graphite.** Same.

E. Hitchcock: Geol. Mass., p. 347.

1838. **Molybdenite.** Brimfield.

In granite with salite.

J. W. Foster; Am. Jour. Sci., 1st series, Vol. XXIII, p. 399.

1841. **Graphite.** Same.

E. Hitchcock: Geol. Mass., final report, p. 607.

1866. **Graphite.** Northfield.

"Black-lead mine" on land of Mr. Piper. A highly plumbaginous mica-schist.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

(This occurs one-half mile south of Mr. F. W. Piper's house on the gulf road in Conway schist. Broad pieces 10 mm. thick of very pure graphite can be obtained, showing the finest slickensides or striation caused by the slipping of the mass under pressure. The coarse rich red-brown biotite, which is interfoliated with the graphite, is also much influenced by undergoing pressure on a yielding substratum. It is at times full of secondary cleavages or gliding planes, and at times drawn out into a straight fibrous form of great beauty. A broad plate has been sheared across by many planes at right angles to the base and then each of these rods has been crumpled into a coarse fiber.)

1876. **Graphite.** Leverett lead mine, south mine.

In a mass 1 by 1¼ inches, finely slickensided, entangled with barite and quartz on side of 2-inch barite vein.

1885. **Graphite.**

Graphite occurs as coloring matter in the Conway and Goshen schists, across the State on the west side of the river, and in Northfield on the east side, and in shining scales in the garnet hornblende rock at "Pike's Peak," Prospect street, Amherst, and in the Brimfield schist along the eastern border of the three counties, and all the citations above refer to the unimportant occurrences of this character, except that from Brimfield, where the Brimfield graphitic fibrolite schist becomes locally a quite pure graphite schist, which was extensively mined for many years just east of Brimfield, in Sturbridge.

1886. **Graphite.** Charlemont.

Excavation has been made on a quite large bed of impure graphite, about 5 feet wide, about 40 rods northeast of the house of Joseph Tinkham, in the Hawley schist.

1895. **Graphite.** South Hadley.

At Larrabee's quarry quite large scales of graphite occur in considerable abundance upon the surface of the layers of sandstone. They must have been carried across the bottom of the Triassic bay from near Wilbraham and have been derived by the streams from the region about Brimfield.

GYPSUM.

1823. **Gypsum.** Deerfield.

In amygdaloidal greenstone in Deerfield in small quantities; white and retaining its water of crystallization. Found by Dr. Cooley and determined by Professor Silliman.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 212.

1826. **Sulphate of lime** (Gypsum).

In layers in slate in West Springfield, like fish-scales, one-half inch in diameter.

E. Davis: Rocks and minerals of Westfield; ibid., Vol. X, p. 215.

1835. **Gypsum.** West Springfield and South Hadley.

Minute quantity.

E. Hitchcock: Geol. Mass., p. 209.

1859. "**Moulds of organisms.**" South Hadley Falls.

E. Hitchcock: Cat. of State collection; Rep. of Board of Agriculture, p. xxi, No. 154.

On examining the specimen in the Survey collection I find there are very flat prismatic cavities often nearly an inch across and resembling exactly the shapes very commonly taken by gypsum crystallizing in clay. They occur in a red argillaceous shale. I have found the same forms at the railroad cut near the dam in Holyoke.

1882. **Selenite.** Deerfield.

Professor Hitchcock mentions that selenite had been found in the Deerfield trap by Professor Silliman (Am. Jour. Sci., 1st series, Vol. V, p. 212), and described molds of unknown crystals left in the quartz of the zeolitic veins east of Deerfield. Casts taken from these molds show that the mineral which has disappeared was selenite, which occurred here very abundantly and in well-formed crystals 20 mm. long. The quartz rises into the molds in sharp parallel crests where it had penetrated between the laminæ of the selenite along the perfect cleavage.

In the Cheapside veins similar but smaller negative crystals occur in the prehnite which at times rose around and covered the selenite before its disappearance, forming thus rude pseudomorphs; and I suspect that part or all of the abundant gashing of the prehnite, quartz, and datolite may be due to this mineral.

B. K. Emerson: Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 351.

1891. **Gypsum.** Delaney's quarry, Northampton, near Holyoke north line.

Surfaces of the trap are covered with pyrite. Above this is a thick layer of calcite slashed by deep cavities 27 mm. long by 3 mm. wide, which are the casts of crystals that have disappeared. The bottom of the cavity is ribbed, as is often the case with gypsum crystals, and such have probably occupied the cavities.

The finding of anhydrite in the trap at Delaney's quarry strengthens the probability of the above interpretation of the negative crystals of the trap.

HALOTRICHITE.

1876. **Halotrichite.** Bernardston.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 2.

(I know nothing of this mineral. Any specimens which may have existed were probably destroyed in the burning of the Shepard cabinet.)

HAMPSHIRITE.

1822. "Crystallized steatite." Middlefield.

"This rare mineral was found by Dr. E. Emmons. * * * The crystals usually occur in groups on masses of steatite. On a piece 3 inches long and 2 inches broad are more than 40 crystals. Some are three-eighths of an inch in diameter and more than half an inch in length. I have one which is double the dimensions just mentioned.

"The surface of the crystals is of a brown color, produced by the action of the weather; but when the crystals are separated their faces are of a yellowish-white color; when fractured, the crystals present an uneven surface, with a structure inclined to the fibrous. The same fibrous appearance is seen on some parts of the steatite—which is destitute of crystals.

"The crystalline structure is exceedingly indistinct, except near the surface. The predominant form of the crystal is a six-sided prism, terminated at one or both extremities by a pyramid of the same number of sides. The truncations are numerous; sometimes on the edges of the prisms or pyramids, and at others on the angles or at the vertex of the pyramid. * * * They very much resemble some quartz crystals."

Then follows an argument against their being pseudomorphs, which is directed against their being pseudomorphs by replacement, and the author concludes that they are crystallized steatite.

Prof. C. Dewey: Am. Jour. Sci., 1st series, Vol. IV, p. 274.

1822. Crystallized steatite. Middlefield.

"I have lately visited the locality of this mineral. It is found in the great bed of serpentine in Middlefield; * * * only in one place between two layers of serpentine; * * * in steatite, 2 or 3 inches thick, the upper surface of which is covered with these crystals. The crystals are, however, separated from the superincumbent mass of serpentine by a thin layer of asbestos (chrysotile) pressed down entirely close upon the crystals, and if it be carefully removed from them shows the form of the heads of the crystals.

Prof. C. Dewey: Ibid., Vol. V, p. 249.

1823. Crystallized steatite.

Analysis.

H_2O	15.00
SiO_2	50.60
Fe_2O_3	2.59
MgO	28.83
MnO_2	1.10
Al_2O_3	.15
Loss	1.73
	100.00

Sp. gr. 2.

C. Dewey: Am. Jour. Sci., 1st series, Vol. VI, p. 333.

1825. Crystallized steatite.

Above cited.

C. Dewey: Geol. of part of Mass., ibid., Vol. VIII, p. 51.

1835. Steatite after quartz.

President Hitchcock cites the discoverer, Dr. Emmons, as believing that these crystals are those of steatite, but, without expressing a definite opinion, seems to believe that they are after quartz, with which, he says, they correspond exactly.

E. Hitchcock: Geol. Mass., 1835, p. 377.

1843. **Steatite after quartz.** Middlefield.

Blum cites the above from Hitchcock, and does not hesitate to class the occurrence as a pseudomorph of steatite after quartz.

Pseudomorphosen, p. 124.

1852. **Saponite.** Middlefield.

Hampshirite (Hermann) quoted as a synonym.

In serpentine and as pseudomorphs copying crystals of quartz. (I can not learn where the name was published by Hermann.)

C. U. Shepard: Treatise on Min., p. 151.

1868. **Aphrodite** (subspecies); Hampshirite. No locality.

Its purity and individuality as a species doubted.

J. D. Dana: Sys. Min., p. 457.

1887. **Hampshirite.** Chester. (See Pl. I, fig. 4.)

There is in the Clark collection, now in Smith College, a unique and remarkable specimen, with this curious label: "Hampshirite; steatitic pseudomorphs after quartz; Chester, Mass., on the road to Middlefield. Locality exhausted and filled up with rocks to prevent anything more being taken from it. Bailey thinks this specimen could not be duplicated. From Rowe's collection. He procured it at the locality for $10.00."

This label is in Mr. James Clark's handwriting. The piece is so interesting that I have figured it in Plate I, D.

It proves to be a pseudomorph after olivine, and to follow quite closely the type figured by Des Cloizeaux. Man. Min. Atlas, Vol. VII, p. 41, from Torre del Greco, showing the faces ∞P (110), $2 P \breve{\infty}$ (021), $4 P \breve{\infty}$ (041), $\infty P \breve{\infty}$ (010), P (111). ∞P measured 129° 30′ to 131° 30′; true angle, 130° 2′. $2 P \infty$ = 79° to 81° 30′; true angle, 80° 53′. The crystals are in stout prisms up to 4 cm. long; brownish-yellow, and covered in large part by a secondary deposit of a compact fibrous greenish-white chrysotile, sp. gr. 2.24.

The discrepancy in the localities of the "crystallized serpentine" above and the "hampshirite" arise from the fact that the great serpentine mass extends into both towns. They both refer to the same locality. There were fine specimens in the Shepard collection. With the exception of these crystals, I have never been able to detect any trace of olivine by a careful microscopical study of every serpentine outcrop on the west side of the river. Mr. M. E. Wadsworth cites a peridotite from the Westfield River, but says the olivine structure is wholly gone, and his figure shows only the square-meshed enstatite structure. (Lithological Studies, Pl. 7, p. 2.) As indicated above, the locality is now lost.

1892. **Hampshirite.** No locality.

The data given in 1868 are cited without essential change. "Probably not homogeneous."

E. S. Dana: Sys. Min., p. 675.

HEMATITE.

1818. **Specular oxide of iron.** Hawley, Bernardston, Warwick.

Veins wrought to some extent.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 115.

1819. **Specular oxide of iron.** Montague.

"In a detached eminence 100 feet high on land of Mr. Taft, near mouth of Millers River. The whole hill traversed by numerous veins, and scarcely a foot of the rock is to be found which does not contain them, varying in width from a mere line to several inches. The principal vein appears on

1819. **Specular oxide of iron**—Continued.

the top of the hill, and is, as nearly as I could determine, not less than 10 feet wide, lying in a north and south direction. Ore abundant and generally pure. Masses that have been separated by blasting and weighing 100 to 200 pounds lie on the surface; pyrite present; the gangue is quartz. The walls and hill are composed of granite."

E. Hitchcock: Sup. Geol. Deerfield; ibid., p. 438.

1822. **Micaceous oxide of iron.** Hawley.

"Of extreme beauty; is found a few miles from Northampton. It has high luster and is contorted with delicate flexing, as if it had lain between the layers of mica-slate, which we presume must have been the fact. Dr. Hunt and Mr. W. C. Dwight, of Northampton, have favored us with specimens, and similar ones from Hawley, in Massachusetts, have been transmitted by Dr. Jacob Porter, of Plainfield; this last is particularly beautiful and is sprinkled with points of magnetic iron."

Editor's note: Am. Jour. Sci., 1st series, Vol. IV, p. 53. (Both parts of this note refer to the same locality.)

1823. **Specular oxide of iron.** Same.

Ibid., Vol. VI, p. 207.

1823. **Micaceous oxide of iron.** Bernardston.

With magnetite, like Hawley, in "talco-argillite."

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 208.

1823. **Micaceous oxide of iron.** Hawley.

Northwest part of town in talcose slate; the principal bed of the ore varies from 6 inches to 3 or 4 feet thick. Mine opened 20 or 30 rods long, 30 or 40 feet deep. Magnetic oxide most abundant; the micaceous oxide not wrought, from the belief that it would not smelt.

Ibid.

1825. **Hematite?** Vitreous black oxide of iron.

Southampton lead mine, in carbonate of lead. Before blowpipe infusible, becomes magnetic.

C. U. Shepard: Min. Loc.; Am. Jour. Sci., 1st series, Vol. IX, p. 47.

1825. **Micaceous iron.** Northampton (misquotation of 1822 above for Hawley).

High luster, contorted (Cleaveland.) Warwick; wrought to small extent (Am. Jour. Sci., 1st series, Vol. I, p. 115).

Robinson's Cat., p. 64.

1827. **Hematite.** Hawley, at junction of mica and talcose slate.

A. Nash: Lead mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 245.

1841. **Micaceous specular iron ore.** Hawley.

Formerly rejected as worthless, but is an exceedingly rich ore.

Analysis.

Fe_2O_3	99.26
H_2O	.60
Loss	.14
	100.00

Also Montague.

E. Hitchcock: Geol. Mass., p. 196.

1879. **Hematite.** Hawley.

West of the Center is a hill containing a rich deposit of iron ore which was mined about 1800 to supply a furnace near by, and which gave the name of "Forge Hill" to this locality.

Hist. Conn. Valley, Vol. II, p. 704.

1885. **Hematite.**

In minute spheres with concentric structure superficially embedded in quartz crystals, so as always to fill the same half of the surface of each crystal, as if the solution had dripped down a vertical fissure, which was covered with the growing quartz crystals. In diabase south of Titan's Piazza.

Discovered by Prof. J. M. Clarke.

1886. **Hematite.** Hawley.

The fine micaceous ore is a bed intercalated in the schists adjacent to a fault, and the mineral may be regarded as a pseudomorph by replacement of muscovite. It is for the most part a quartz-hematite schist or itabiryte, of which the texture is exactly like that of the adjoining mica-schists, with which it is conformable, only that the mica is replaced by the scales of specular iron. It is interesting to note that a similar replacement of biotite by specular iron occurs among the minerals formed by the partial melting of the olivine-rock inclosures in basalt.[1]

In the case before us I think it probable that heated waters occupying the fissure, and borrowing iron from the adjoining ankerite, have replaced the mica along the sides of the opening.

1891. **Hematite.** South of Northampton.

Quarry in sandstone beside Connecticut River Railroad, at north line of Holyoke.

Fine broad layers 3 mm. thick with botryoidal and drusy surface made of shining plates set edgewise in fissure in brown stone. These plates are formed by the large development of the plane 0. It also impregnates the sandstone. In both cases it is just above diabase, which gives every indication of having been so quickly covered that the heat of the mass greatly quickened the circulation and increased the chemical activity of the solutions which permeated the covering of sand, cementing it and filling its fissures with the hematite.

HERMANNITE.

See Rhodonite.

HEULANDITE.

1825. **Heulandite.** Chester.

"In the cabinet of Dr. Emmons in Chester I was shown specimens of a mineral considered as stilbite, which I at once recognized to be heulandite crystals about one-eighth inch long. Locality exhausted."

C. U. Shepard: Bost. Jour. Phil., Vol. III, p. 608.

1825. **Heulandite.** Chester.

Right oblique prism, acute edges replaced; white; with chabasie and stilbite in mica slate.

E. Emmons: Min. Not., Am. Jour. Sci., 1st series, Vol. X, p. 11.

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[1] K. Bleibtreu: Zur Kenntniss der Einschlusse in den Basalten; Zeitschrift der deutschen geol. Gesellschaft, Vol. XXXV, p. 546.

1831. **Lincolnite.** (Hitchcock.) Deerfield.

Full description, figure, and measurements; named after the then governor, Lincoln. From trap of Deerfield Mountain, east of village.

E. Hitchcock: Geol. Mass., p. 437.

1841. **Lincolnite.** In trap, 1 mile east of Deerfield.

Description, figures, and measurements.

Ibid., p. 662.

1843. **Heulandite.**

Declaring the lincolnite to be heulandite and M > T to be 130°.

F. Alger: Proc. Bost. Soc. Nat. Hist., Vol. I, p. 145 (abstract); Bost. Jour. Nat. Hist., Vol. IV, p. 245; also Am. Jour. Sci., 1st series, Vol. XLVI, p. 233.

1844. **Heulandite.** (*Zeolus rhomboideus.*) Deerfield. Chester.

J. D. Dana: Sys. Min., p. 324.

1844. **Lincolnite.**

Wishes an arrest of judgment concerning the identity of lincolnite and heulandite, and states that the crystals sent to Mr. Alger were from a second and later find, a few rods from the first; gives a later measurement of Professor Shepard as 116° 45′ to 117° 15′.

[Editor's note: The angle measured is not the primary lateral angle 130° 30′, but the angle of T (0) on $\tilde{i}$ (2-i) = 115° 10′.]

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. XLVII, p. 416.

1844. **Heulandite.**

Lincolnite is heulandite.

F. Alger: Alger's Phillips Min., p. 37.

1845. **Lincolnite.**

Professor Shepard defends the species and gives a new series of measurements, obtaining 117° 08′ 06″; to which B. Silliman, jr., in a note, rejoins that if the new measurements given by Professor Shepard in the above note be correct the corresponding angle of H would be 116° 17′.

Am. Jour. Sci., 1st series, Vol. XLVIII, pp. 175, 179.

1845. **Lincolnite.**

Thinks that the modifying plane suggested in the note of the editor appended to last paper does not settle the question, "for the modifying plane mentioned occurs rarely, as it is extremely narrow, and it could not be confounded with the primary plane by so practiced an observer as Professor Shepard."

Mr. Teschemacher informs him that he did not know he was measuring the lincolnite, and so gave it no special care, and does not wish to be quoted as asserting the identity.

[Editor's note: The plane $\tilde{i}$ enlarged may obliterate M, one of the primary faces, or nearly obliterate it, and then the narrow plane left would be the one alluded to above.]

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. XLVIII, p. 64.

1846. **Lincolnite.**

Peculiarities in the modifying planes have given rise to a secondary form rarely observed in heulandite. These consist in the enlargement of the planes *f* (Phillips) or $\tilde{i}$ (Dana), so as nearly to obliterate the planes M, being in fact the reverse that we observe in heulandite from other localities.

In the measurements by Professor Hitchcock and Professor Shepard the angle of *f* on T was mistaken for M on T, and in the figure given by Professor Hitchcock it is evident that the plane lettered M should be *f*.

1846. **Lincolnite**—Continued.

The true value of *f* on T is 115° 10′ (Dana). Professor Shepard's last measurement made is 116° 17′.

F. Alger: Loc. of rare min.; Bost. Jour. Nat. Hist., Vol. V, p. 306.; Proc. Bost. Soc. Nat. Hist., Vol. II, p. 89 (abstract).

1852. **Heulandite**. "Lincolnite (heulandite) belongs here."

C. U. Shepard: Min., 3d ed., p. 163.

1876. **Lincolnine**. Deerfield.

C. U. Shepard: Cat. Min. 75 miles of Amherst College, p. 4.

Given in accordance with his suggestion to use "ine" for minerals whose specific character is not fully settled, a suggestion which has not been anywhere adopted.

1880. **Heulandite**. Amherst.

At Pikes Peak, a small projecting rock at the north end of Prospect street, now blasted away for the foundation of a house, in a quartz-garnet-hornblende rock, beautiful brick-red crystals (P, M, T, N, *z*) 3 mm. long, tabular on M, and in drusy crystalline surfaces, on fissures with very fresh pyrite, plainly of very recent development.

1882. **Heulandite**. Deerfield.

This mineral occurs quite abundantly at the new cutting in small, stout prisms, *i-i*, 2-*i*, $\bar{2}i$, up to 2 mm. in length, with sharp edges and no indication of other faces. It is the lincolnite of President Hitchcock, and the specimens studied by me agree exactly with those labeled lincolnite by him, and coming from the old locality east of Deerfield. The mineral collection at Amherst contained a few crystals also identical with the above, from the Fitchburg railroad cutting, and these were separated by Professor Shepard from heulandite under the name lincolnite.

After careful study I find all these crystals identical with each other and with heulandite, both optically and crystallographically.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 357.

HORNBLENDE.

See Amphibole.

HUMOFERRITE.

1876. **Humoferrite**. (Shepard. See Limonite, 1876.)

An unused synonym.

ILMENITE.

See Menaccanite, 1846.

INDIANITE.

See Oligoclase, 1865.

ISERINE.

See Menaccanite, 1835.

JEFFERISITE.

1870. **Vermiculite** or **Jefferisite**. Pelham.

Irregular veins separated by a decomposed asbestos, an altered mica; H. = 1.5; luster pearly, sometimes metallic; exfoliates, fuses on edges; shows six-rayed asterism.

J. H. Adams, class of '70, Amherst College; Am. Jour. Sci., 2d series, Vol. XLIX, p. 271.

1870. **Vermiculite?.** Pelham.

Loses 7 per cent by ignition; 50 per cent dissolved in aqua regia, leaving white scales resembling margaric acid. They are so remarkable for their uniformity of size, freedom from color, and pearly luster as scarcely to suggest their inorganic composition. Under the microscope, however, they give very nearly the distinct lateral cleavage line of mica. Nor have they the perfect elasticity of a true mica. They show no tendency to further exfoliation when heated. Before the blowpipe they melt with difficulty on the edges into a colorless glass. Professor Des Cloizeaux was kind enough to examine some of these scales optically and found them to be uniaxial; the exfoliation caused by the coating of the mica scales with a hydrated argillaceous mixture, which probably owes its origin to the decomposition of some other member of the micaceous or chloritic family.

Al_2O_3	14.00
MgO	13.68
Fe_2O_3	32.00
Si_2O_3	24.00
Alk(?)	(?)

C. U. Shepard: Min. Contrib.; ibid., Vol. L, p. 96.

(Prof. L. Mears found the margaric acid-like scales obtained by boiling the above vermiculite in aqua regia to dissolve in K_2O, hence they are SiO_2.)

1875. **Pelhamite.** Pelham.

Full description and analysis.

J. P. Cooke, jr.: On the new varieties of vermiculites; Proc. Am. Acad. Arts Sci., Vol. X, p. 453, Boston.

1891. **Jefferisite.** Pelham.

New excavations have produced crystals 4 inches square and nearly an inch thick, exactly like those from Westchester, Pa. They are a rich bronze-brown, often bent. They are derived from the biotite which surrounds the olivine rock.

KAOLINITE.

1823. **Porcelain clay.** Plainfield (Silliman), Conway, and Leyden, in small quantities.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 229.

1827. **Kaolin.** Williamsburg; of superior quality. Conway.

A. Nash: Lead mines of Hampshire County; ibid., Vol. XII, p. 261.

(The first may be the infusorial marl recently patented by a man in Williamsburg as a filling for piano frames.)

1831. **Porcelain clay.** Norwich, at lead mine.

Analysis.

H_2O	8.00
SiO_2	53.40
Al_2O_3	36.26
CaO	.24
MgO	.68
MnO	.20
	98.88

E. Hitchcock: Economic Geol., p. 130.

1880. **Kaolinite.** Amherst.

Well at northwest corner of College Grove.

Green, soft lithomarge from decomposition of orthoclase, muscovite, and fibrolite of coarse granite, and forming pseudomorphs of these minerals. It represents the surface of the granite which has been rotted beneath the Triassic sandstones, now newly exposed by glacial erosion.

Analyses made in the laboratory of Amherst College.

	No. 1.	No. 2.	No. 3.
SiO_2	46.96	44.39	46.50
Al_2O_3	28.01	33.54	35.62
Fe_2O_3	3.14	2.13	
MgO	3.58	6.41	4.54
K_2O			2.59
H_2O	11.14	12.60	11.57
	92.83	99.07	100.82

1882. **Kaolinite.** Deerfield.

"Along the shore in Greenfield, opposite Turners Falls, and especially on the new road between these towns, the nodules of the radiated prehnite are in whole or part changed into a white kaolin (?), the change uniformly commencing from the different centers of radiation and proceeding regularly outward. Under the microscope the kaolin-like material separates into opaque granules so extremely minute that they show in water the Brownian movement with wonderful perfection."

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 349.

1883. **Kaolinite after garnet.** Bernardston.

In the Leyden argillite, on the north line of Bernardston, minute garnets have been changed to a mass of soft clay, which still fills the cavities.

1888. **Kaolinite.**

The thin laminated clays of Champlain age which rest directly on the till in the Connecticut River valley and those of the Brimfield Lake will be described in full in the monograph on the geology of the region. They are extensively worked for brick in Turners Falls, Greenfield, Northampton, Amherst, Holyoke, Chicopee, South Hadley, Springfield, and Brimfield.

1890. **Kaolinite.** Blandford.

Extensive works have been erected by the Blandford Brick and Tile Company in Russell to work a deposit of clay found in Blandford many years ago by Mr. G. L. Twitchell.

"Sworn analyses by chemists of the Massachusetts Institute of Technology show the existence of a bed of kaolin * * * of the most valuable sort and in a quantity that is known to exceed 80,000 tons. * * * A comparative analysis shows that the Blandford clay is superior to the Mount Savage clay, the only American basis for fire brick that is worthy of notice, and even to the Sturbridge clay from England and the Chinese kaolin. Its finer strain makes a brick of the purest white."

Springfield Republican, December 6, 1890.

1890. **Kaolinite.** Blandford.

Situated just east of the village and due to the preglacial decomposition in situ of veins of coarse feldspathic pegmatite.

Analysis.

[By Dr. L. M. Norton, Institute of Technology.]

SiO_2	52.03
Al_2O_3	31.76
H_2O	15.55
MgO	.54
Fe_2O_3	Trace.
CaO	Trace.
Alkalies	Trace.
	99.88

W. O. Crosby: The Kaolin in Blandford, Mass.; Technology Quarterly, Vol. III, p. 228.

KALINITE.

1818. **Native alum.** Leyden.

Efflorescing in small quantity on argillaceous slate.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. 1, p. 114.

1824. **Alum.** Ware, in mica-slate.

C. U. Shepard: Min. Loc.; ibid., Vol. VIII, p. 235.

1825. **Alum.**

Conway, on mica-slate; Leyden, in carbonaceous clay; Ware, in mica-slate.

Robinson's Cat., pp. 45, 56, 73.

1835. **Alum.** Ware.

In gneiss.

E. Hitchcock: Geol. Mass., p. 398.

1841. **Alum.** Conway, northeast part.

Abundant.

Ibid., p. 604.

The pyritous Hawley schists and the rusty fibrolite Brimfield schist along the eastern border of the area show abundant white efflorescences of mixed iron and alumina sulphates.

KEROLITE.

See Bastite and Deweylite.

KILLINITE.

See Muscovite, 1879.

KNEBELITE.

1880. **Knebelite.** Plainfield.

There was in the Shepard collection (now burned) a specimen labeled by Professor Shepard "Tephroite, knebelite, Mg(Fe)SiO_3." It was dull yellowish-brown in color and of fibrous texture, apparently common hornblende.

LAUMONITE.

1835. **Laumonite.**

In amygdaloid in Massachusetts in small masses.

C. U. Shepard: Min., Part II, Vol. II, p. 3.

1835. **Laumonite.**

Doubts its occurrence.

E. Hitchcock: Geol. Mass., p. 436.

1841. **Laumonite.**

Not found in greenstone in Massachusetts.

E. Hitchcock: Geol. Mass., p. 662.

1876. **Laumonite.** Monson.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 4.

1882. **Laumonite.** Monson.

Large pieces of massive laumonite, white to pink, from Monson quarry. In a north-south fissure in the north end of the quarry the gneiss is much decomposed and the fissure filled with laumonite, massive, granular, and in quite large finely terminated crystals, ∞ P (110) — P ∞ (100), 26 mm. long, 1½ mm. wide. The vein is permeated with bands of leek-green hornstone.

1886. **Laumonite.** Northampton. Quarry in granite south of W. N. Moore's, east of Florence.

Hollow pseudomorphs of albite after laumonite; fine drusy without and within, 10 mm. long ∞ P (110) — P ∞ (101). They rest on laumonite and quartz.

LAZULITE.

1893. **Lazulite.** Greenfield.

In 1892 Mr. C. C. Russell, of the class of 1894 in Amherst College, picked up in the bed of Hinsdale Brook a white vein-quartz bowlder nearly 4 inches long and 2½ inches square on cross section, having a glacial shape, smoothed on the four sides and rough on the ends, but later considerably waterworn. The half of one side is of deep azure blue of the shade of the Chrowder's Mountain lazulite and deeper than that of Grave's Mountain, Georgia. It is in squarish cross sections of imperfect crystals nearly half an inch across and the material extends a half inch into the mass. The quartz is a clear, white, greasy, vein quartz, which has parallel to a plane of schistosity thin films of magnetite, and these graduate into films of a magnetite-muscovite-fibrolite schist. I am wholly at a loss to locate this schist in any region from which the ice could bring the bowlder to this place, since fibrolite is wholly wanting in the rocks to the west and northwest across the Green Mountains, so far as I have examined them. The only other locality for lazulite in the United States is in Georgia.

LEPIDOLITE.

1835. **Lepidolite.**

"Dr. Emmons is of opinion that the 'large cleavable variety' of crystals occurs at Goshen. Probably he refers to the mineral that has generally been regarded as rose mica."

E. Hitchcock: Geol. Mass., p. 504.

This was doubtless muscovite.

1879. **Lepidolite.** Chesterfield, in cleavelandite.

A. A. Julien: Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 351.

LIMONITE.

1818. **Eagle stone**, or **nodular argillaceous oxide of iron.** Deerfield.

One specimen on banks of Deerfield River.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 116.

1819. **Bog iron ore.** Greenfield, Warwick.

E. Hitchcock: Sup. to Geol. Deerfield; ibid., Vol. I, p. 436.

1823. **Nodular argillaceous oxide of iron.** Gill, near Falls, in dark hard slate of coal formation.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 233.

This refers to the abundant flattened egg-shaped concretions of pyrite changed to limonite found in the Triassic slate.

1827. **Iron bed**; **bog iron ore.** Williamsburg.

One-half mile below village, 30 rods south of Northampton road.

A. Nash: Lead mines, etc.; ibid., Vol. XII, p 258.

1832. **Limonite.** Greenfield, Northampton, Springfield, Williamsburg.

E. Hitchcock: Geol. Mass.; Am. Jour. Sci., 1st series, Vol. XXII, p. 55.

1835. **"Vitreous black oxide of iron."** Southampton lead mine.

E. Hitchcock: Geol. Mass., p. 507.

1835. **Limonite, nodular.** Gill, in slate of the coal formation.

C. U. Shepard: Min., 1st ed., Part II, Vol. II, p. 15.

(See 1823, above.)

1838. **Ocher.** Monroe.

No. 162 in State collection from Morton Ballou; formerly dug for paint; abandoned.

E. Hitchcock: Report on Economical Geol., p. 128.

1841. **Bog ore.** Warwick, Greenfield, Northampton, Springfield, Williamsburg.

E. Hitchcock: Geol. Mass., p. 198.

1852. **Limonite.** Gill, in slate of the coal formation.

C. U. Shepard: Min., 3d ed., p. 277.

1865. **Ocher and sienna.** East Whately.

Discovered and used above fifty years ago; is on land of Elihu Belden; called American sienna; used mixed with milk as a paint. Covers one-half acre 30 rods from Connecticut, in a long depression in the meadow extending from north to south. Is immediately below turf, 10 to 30 inches thick; rests on loam. Probably a spring deposit, very homogeneous and fine grained; ocher sienna-brown, and when ignited a red to burnt sienna.

Analysis.

	SiO_2.	Fe_2O_3.	Al_2O_3.	H_2O.	Total.
Deepest yellow	13.00	70.00	3.60	13.00	99.60
Do	20.00	63.30	5.00	11.70	100.00
Yellowish-brown	47.00	35.00	6.00	10.80	98.30
Brown	53.00	28.00	6.00	13.00	100.00
Pale yellow	63.00	17.50	7.00	12.50	100.00

Highly commended.

Report of Prof. Charles Upham Shepard's analysis of the East Whately ocher and sienna mine; Amherst, Mass., January 18, 1865.

1865. **American sienna.** Whately.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 2.

1876. **Humoferrite.** (Shepard.) Whately.

C. U. Shepard, Cat. of Min. within 75 miles of Amherst College.

"Its true character is that of a light river sediment highly charged with peroxide of iron, which ingredient forms one-sixth to three-fourths of its weight."

C. U. Shepard: Report Whately ocher and sienna mine, p. 4.

(Name not adopted.)

1876. **Melinine.** (Shepard.) Turners Falls.

C. U. Shepard: Ibid., p. 4. (See Limonite, 1823. The name has never been adopted.)

1879. **Bog iron.** Brimfield.

Formerly worked to considerable extent on farm of Charles Bugbee, since occupied by Michael Travers.

Hist. Conn. Valley, Vol. II, p. 994.

1891. **Limonite.** Bernardston.

Impregnates and replaces the limestone at Williams's farm in quite large amount.

1891. **Limonite after calcite.** Loudville lead mine.

Form $\infty P, -\frac{1}{2}R$, 5 mm. long; on quartz.

In Clark collection, Smith College.

LINARITE.

1891. **Linarite.** Manhan lead mine, Loudville.

In deep blue-bladed crystals in a cavity in quartz, determined by Professor Shepard. As there are only two small crystals known, no attempt was made to verify the occurrence. Color and form agree well with linarite.

Specimens in Amherst and Smith College collections.

LINCOLNITE.

1831. **Lincolnite.** See Heulandite.

MAGNETITE.

1818. **Iron sand.** Turners Falls, Montague side.

Considerable quantity.

E. Hitchcock: Geol Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 115.

1818. **Magnetic oxide.** Common west of the Connecticut River.

Ibid.

1822. **Magnetite.** Middlefield.

Octahedrons in mica-slate (Eaton).

Cleaveland: Min., Vol. II, p. 596.

1823. **Magnetic oxide of iron.** Plainfield, Shelburne, Shutesbury, etc.

In small octahedrons in mica slate and gneiss. Hawley, in beds in talcose slate. Bernardston, in beds.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 232.

1824. **Magnetic oxide of iron.** Plainfield, Cummington.

Plainfield, cubic crystals in arenaceous quartz. Cummington, with cummingtonite (Dewey).

J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VIII, p. 233.

1825. **Magnetite.** Zoar, Hawley.

Octahedra in chlorite.

Robinson's Cat., pp. 52, 78.

1825. **Magnetic oxide of iron.** Cummington.

J. Porter: Min. Loc.; Am. Jour. Sci., 1st series, Vol. IX, p. 55.

1826. **Magnetic oxide of iron.** Plainfield.

A small bed has lately been discovered.

J. Porter: Min. Not.; ibid., Vol. X, p. 18.

1826. **Magnetic iron.** Monson.

Abundant in gneiss.

S. Colton: Min. Not.; ibid., p. 13.

1833. **Magnetic oxide of iron.** Hawley.

Principal ore magnetic oxide; not abundant; bed rarely more than 1 to 2 feet wrought; now abandoned; owned by Hon. Samuel C. Allen. Appears 1 to 2 miles south and 2 to 3 miles north in Charlemont. (See Hematite.)

E. Hitchcock: Geol. Mass., p. 53.

1835. **Magnetic oxide of iron.** Blandford, Chester.

Octahedra in mica-slate.

Everywhere in the "chlorite slate."

Ibid., pp. 347, 363.

1838. **Magnetite.** Warwick.

Probably the most extensive in the State. Attempt to work it abandoned because of impurity. No. 177 in State cabinet; from Alden Spooner.

Analysis.

Fe_3O_4	66.4
MnO_2	16.6
SiO_2, Al_2O_3	17.0
	100.00

E. Hitchcock: Economic Geol., p. 124.

1841. **Magnetite.** Chester, Blandford, Warwick, Bernardston.

Chester. In talcose slate. The beds of magnetic oxide of iron in the west part of Chester, which are nearly a foot wide, occur in hornblende slate; but this appears to me to be interstratified with the talcose slate, so that probably the ore should be regarded as a continuation southerly of the beds in Hawley.

Blandford. Association not known.

Warwick. Near east line in mica-slate; at least two beds several feet wide; ore abundant, very compact; sp. gr. 4.47.

Analysis.

Fe_2O_3	46.34
FeO	20.70
SiO_2	15.28
MnO	7.92
MgO	4.18
CaO	4.88
Loss	.70
	100.00

1841. **Magnetite**—Continued.

Bernardston. Near the limestone.

Analysis.

Fe_2O_3	57.86
FeO	29.98
SiO_2	9.90
MgO	5.42
MnO	.54
Loss	.30
	100.00

E. Hitchcock: Geol. Mass., pp. 194, 612.

1841. **Magnetic oxide of iron.** Blandford, Chester.

Octahedra; in mica slate. Ibid., p. 607.

1841. **Magnetic oxide of iron.**

In chlorite slate; abundant; also more rarely in talcose slate.

E. Hitchcock: Ibid., p. 613.

1841. **Magnetic oxide of iron.**

In small disseminated masses in Shelburne in gneiss.

Ibid., p. 637.

1865. **Magnetite.** Chester.

Massive, thin-veined, granular, and disseminated. Massive variety perfectly pure and unmixed between the coarse-grained Lake Champlain ore and the fine-grained Swedish. In fracture slightly purplish tint, blacker than usual, free from pyrite and rust, no native magnets; magnetic with polarity. On top of North Mountain a continuous seam 10 to 15 inches wide in a chloritoidal vein 4 to 5 feet wide of disseminated magnetite; this forks off from the main vein on the east at 30° in talcose slate, sunk upon 25 feet. No emery; seen again 600 feet on; also on South Mountain 6 to 8 inches thick; has trace of titanium.

C. U. Shepard: Report Chester emery mine.

1886. **Magnetite.** Monson, Flint's quarry.

In broad sheets of muscovite in flattened reticulated bands, twinned after the octahedron, as at Liepersville, Pa., and almost rivaling it in beauty. From the pegmatite of the east wall of the quarry. Best specimens in Amherst College cabinet.

1891. **Magnetite.** Hawley.

This mineral is abundant the whole length of the vein on Forge Hill, replacing the better-known hematite in the bottom of the new shaft sunk at the old mine. It lies in a quartz vein in sericite schist.

1891. **Magnetite.** Plainfield, Charlemont.

Plainfield. Abundant in the continuation of the Hawley vein across this town, associated with rhodonite.

Charlemont. In a considerable vein in the south brow of the hill 1 mile north of village, and in fine octahedra in hornblende chlorite-schist near A. P. Maxwell's.

MALACHITE.

1818. **Green carbonate of copper.** Greenfield.

In greenstone vein on bank of the Connecticut River, passing under the river; not wrought.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 115.

1823. **Green carbonate of copper.** Greenfield.

Two veins considerably abundant; amorphous and earthy.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 231.

1881. **Malachite.** Leverett, Hatfield.

Occurs as coating and small tufts at new opening of Upper Leverett mine, and at Hatfield mine.

1888. **Malachite.** Loudville lead mine.

In layers 10 to 15 mm. thick and in fine tufted groups on chrysocolla; rare; finest specimens in Smith College and Amherst College collections.

1890. **Malachite.** Chester.

In hornblende schist in the shaft of the emery mine; broad films on cleavage planes. Especially abundant in a peculiar olive-green serpentine.

MANGAN-AMPHIBOL.

See Rhodonite.

MARCASITE.

1835. **White iron pyrites.** Cummington and Plainfield with cummingtonite.

C. U. Shepard: Min., 1st ed., Vol. II, p. 159.

1841. **White iron pyrites.** Same.

E. Hitchcock: Geol. Mass., p. 608.

1886. **Marcasite.** Cummington, Mass., and throughout western New England.

Massive and fibrous in mica-schist.

The pyrite of Charlemont is cited as pyrrhotite and pyrite, that of Rowe as pyrite.

A. A. Julien: Decomposition of iron pyrites; Ann. N. Y. Acad. Sci., Vol. III, p. 398.

(All these occurrences are in one band of rock, and I have rarely failed to find cubical crystals at any locality and have never seen rhombic or fibrous forms. Professor Julien's careful studies make his determinations conclusive as to the presence of marcasite with the other sulphides.)

MARGARITE.

1865. **Margarite.** Chester.

"I found that the minerals margarite and chloritoid in talcose hornblende and mica-slate rocks indicated the occurrence of emery."

C. T. Jackson: Am. Jour. Sci., Vol. XXXIX, p. 87.

1865. **Margarite.** Chester.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 112.

1865. **Margarite.** Chester.

Scarcely less characteristic of emery than diaspore, harder and more basic than mica, nonalkaline, frequently with a richness of crystallization and color nowhere else known. Always in near proximity to the purest masses of emery, sometimes traversing it in veins, at others coating more or less perfectly large and small rounded masses of it with layers an inch or more in thickness. Laminæ transverse; sometimes open spaces in middle of margarite seam show terminated crystals, but rarely with crystals of corundophyllite; emery grains everywhere; pinkish, rarely disseminated in emery with epidote; gray and resembles mica.

C. U. Shepard: Report of Chester emery mine, p. 10.

1866. **Margarite.** Chester.

Analysis.

SiO_2	32.21
Al_2O_3	48.87
CaO	10.02
FeO	2.50
MnO	.20
MgO	.32
Na_2O (K_2O)	1.91
LO	.32
H_2O	4.61
TiO_2	Trace.
	100.96

J. L. Smith: Am. Jour. Sci., 2d series, Vol. XLII, p. 90.

1866. **Margarite.** Chester.

Analysis by J. C. Jackson and C. T. Jackson.

Ibid., p. 107.

1885. **Margarite.**

The largest crystals that have come to my notice (100 mm. long), as well as the thickest veins of the mineral (65 mm.), are in the Clark cabinet in Smith College.

The mineral has widely divergent optical axes, and in the large crystals, which show plumose structure on cleavage planes, the successive laminæ of the crystal are placed with their axes making a considerable angle with the axis of the composite crystal, so that in a plate of sufficient thickness exactly the same effect is produced as by building up plates of muscovite with the axes in each plate diverging more and more from the first.

1891. **Margarite.** Pelham asbestos mine.

In connection with the seam of deep blue corundum crystals, bordering the top of the olivine bed, one fine specimen of margarite has been found. Pale pink plates one-half inch across in fine dark bronze biotite. A second piece shows a fine drusy surface of satiny luster and pale-green color, formed by the terminations of many minute implanted crystals, presenting a common face to the surface. Form 0 P (001), ∞ P ∞ (010), ∞ P (100). The specimens were presented to the cabinet of Amherst College by Mr. B. F. Merrill.

MARMOLITE.

See Bastite.

MELANITE.

See Garnet, 1818.

MELANTERITE.

1818. **Sulphate of iron.** Conway.

Small quantity on mica-slate.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 115.

1823. **Sulphate of iron.** Hawley.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 233.

1892. **Melanterite.**

Efflorescence of iron sulphate is not uncommon in the Hawley schists, where pyrite is so abundant, and in the rusty Brimfield schists along the eastern border of the area. The local names "copperas rock" and "dye stone" indicate this.

In the band of rocks running under the western edge of Amherst village the sulphate is so abundant that the well waters sometimes blacken tea.

MELININE.

1876. **Melinine** (yellow ocher). (Shepard.) Turners Falls.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 3. See Limonite, 1823. Unused synonym.

MENACCANITE.

1824. **Oxyd of titanium.** Chester.

"Likewise, I have seen the oxyd of titanium in plates in mica-schist." E. Emmons: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VI, p. 255.

1835. **Iserine.**

Some of the iron sand from the banks of the Connecticut River, 40 rods below Turners Falls, Montague side, not magnetic, and resembles iserine. E. Hitchcock: Geol. Mass., p. 231.

1842. **Washingtonite.** (Shepard.) Goshen.

With spodumene, in thin folia.

C. U. Shepard: Am. Jour. Sci., Vol. XLIII, p. 366.

1844. **Washingtonite.** (Shepard.) Goshen.

F. Alger: Min., p. 381.

1846. **Ilmenite, Washingtonite.**

✓

Analysis by J. L. Kendall:

TiO_2	25.28
Fe_2O_3	51.84
FeO	22.86
	99.98

Is identical in chemical composition and crystalline form with ilmenite.

F. Alger: Location of rare minerals and mines of supposed distinct species; Bost. Jour. Nat. Hist., Vol. V, p. 383; also Am. Jour. Sci., 2d series, Vol. I, p. 122.

1865. **Ilmenite.** Chester.

Thin, curved laminæ with margarite.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 112.

1865. **Washingtonite.** Chester.

Emery vein; rare, black, foliated, much-curved laminæ between the double seams of margarite.

C. U. Shepard: Report of Chester emery mine, p. 11

1865. **Washingtonite.** Chester.

In the principal veins (layer veins) of white quartz that the large crystals of Washingtonite were found in, at one spot within a mile from the northern end of the emery vein.

C. U. Shepard: Discovery of emery mine, Chester; note, p. 5.

(There were in the Shepard collection, destroyed by fire, great tabular crystals 6 to 8 inches across and 1 inch thick of model-like perfection from the locality in Chester mentioned above. They were tabular by the predominance of 0. I can not find that they were ever described by Professor Shepard.)

1866. **Menaccanite.** Chester.

Flattened crystals in margarite.

J. L. Smith: Am. Jour. Sci., 2d series, Vol. XLII, p. 92.

1876. **Menaccanite.** Pelham, Ware.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 7.

1876. **Washingtonin.** Chester.

Ibid.

1880. **Menaccanite.** Blandford. Bartholomew's soapstone quarry.

In large plates in quartz in roadside opposite the quarry.

1881. **Menaccanite.** Ware.

In dull-black, flat crystals up to 1 inch; perfect and abundant in coarse granite near the railroad cut at Gilbertville.

1881. **Menaccanite.** Chester emery mine.

Massive in veinlets in emery; in beautiful, broad, finely striated scales bordering 1-inch vein of margarite and cutting corundophyllite.

1882. **Menaccanite.** Northfield. Calvin Swan's place.

Broad, thin plates in transparent quartz.

In W. E. Webster's collection in Northfield.

1891. **Menaccanite.** Hawley.

In quartz veins adjacent to the magnetite-hematite veins in very fine, large, curved plates in white quartz south of Forge Hill.

MICROCLINE.

1818. **Feldspar.** Deerfield, in pudding-stone.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. I, p. 113.

1823. **Adularia.** West-Springfield. Southampton lead mine (Waterhouse).

In perfect crystals in coarse granite.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 221.

1824. **Green feldspar.** Chesterfield.

"While on a visit to the locality of sappare in that place, I found near the spot where the sappare is obtained fine specimens of green feldspar in granite and associated therewith the siliceous oxide of manganese (rhodonite). It contains small octahedral crystals of magnetite."

C. U. Shepard: Loc. Min.; ibid., Vol. VII, p. 251.

1825. **Green feldspar.** Chesterfield. Green.

Chester; pale-green color, not uniform in structure, foliated, less luster than lighter varieties. Glossy quadrangular prisms in quartz, abundant (Emmons).

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 43.

1825. **Green feldspar.** Chesterfield.

In crystals, in masses; fine; near cyanite location in granite.

Robinson's Cat., p. 43.

1835. **Feldspar.** Pelham.

Feldspar crystals with actinolite, augite, and sphene.

E. Hitchcock: Geol. Mass., p. 398.

1841. **Feldspar.** Belchertown.

In gneiss in Three Rivers. Small but well-defined crystals, primary form with truncation of solid angles, in drusy cavities in tortuous gneiss; also on railroad in Middlefield; Leverett, blue; Goshen, green.

E. Hitchcock: Geol. Mass., pp. 637, 639, 703.

1852. **Feldspar.** (**Adularia.**) Palmer, Middlefield.

Most interesting crystallizations.

C. U. Shepard: Min., 3d ed., p. 189.

1876. **Blue microcline.** Hadley.

From coarse granite dike in Mount Warner, Hadley.

Analyzed by J. Keep, of the class of 1874, Amherst College:

	No. 1.	No. 2.
K_2O	11.62	11.03
Na_2O	3.72	3.90
	15.34	14.93

1876. **Microcline.** (Des Cloizeaux.) Everett (correctly Leverett).

Des Cloizeaux: Un microcline blanc d'Everett, Mass., U. S. A.; Compt. Rendu, Vol. LXXXII, p. 889.

Professor Shepard informed me that the microcline of Leverett furnished by himself was one of those originally investigated by Des Cloizeaux. As there is no rock in Everett, Mass., which could furnish the mineral, the citation above originated doubtless from reading Leverett "L'Everett" on Professor Shepard's labels.

1876. **Microcline.** L'Everett.

Analysis by Pisani.

SiO_2	64.97
Al_2O_3	21.47
MgO	.32
K_2O	12.20
Na_2O	1.78
Ign	.81
	101.55
Sp. gr	2.47

Des Cloizeaux: Ann. Ch. Phi., Vol. IX, p. 433.

1880. **Microcline.** Amherst.

West of middle of long dike east of North Amherst.

Pegmatitic nodules in feldspathic mica-schist, same as original locality in Leverett, changing into a silvery-white muscovite along planes of the following cleavages, which are placed in order of clearness of development: $'\infty P'$, $0 P$, $\infty P \bar{\infty}$, $\infty P \breve{\infty}$. They are in the progress of and as a result of the decomposition of the feldspar and its change to muscovite. Under the microscope the nodules show the structure of microcline. They gave 15 per cent alkali, mostly K_2O.

1880. **Quartz and feldspar.** Hampden County.

Number of mines	2
Capital	$254,000
Hands	23
Wages	$12,300
Value of material (per ton)	$1,600
Product, tons	3,400
Product, value	$44,000

U. S. Census, 1880, Vol. XV, p. 844.

(This refers to the mines of the Pontoosuc flint mills in Blandford, and probably to the quarry near Knightsville in Huntington.)

1885. **Microcline.** Pelham, Monson, Huntington, Russell, Granville, Blandford.

Pelham; occurs in distinct large crystals 7 cm. long; $\infty P \breve{\infty}$, $'\infty P'$, $0 P$, $P \bar{\infty}$, P; white with trace of pink in coarse granitic segregations in Pelham gneiss, Buffom's quarry, T. J. Aldridge, owner.

Monson; in large, nearly transparent, cleavable masses in coarser portions of the gneiss at the south end of Flynt's quarry.

In Huntington the large masses with the spodumene on Norwich Hill often have the green color of Amazon stone.

Russell; left bank of the river, opposite Lower Salmon Falls.

Granville; near Munns Brook.

Blandford; north line at feldspar quarry; fine large cleavable masses and many well-formed crystals a foot on a side.

1889. **Microclin.** Huntington.

"A considerable force of men is at work on the farm of George D. Lyman, near Knightville in Huntington, blasting for feldspar. If found in paying quantities, it is proposed to build a mill near by for crushing it."

Springfield Republican, April 18, 1889.

(Fine white microcline occurs in large masses forming a giant pegmatite.)

MICROLITE.

1835. **Microlite.** Chesterfield.

Full mineralogical description, O, O ∞ O, 2 O 2. In albite; conjectures that the principal ingredient is oxide of cerium.

C. U. Shepard: Microlite, a new mineral species; Am. Jour. Sci., 1st series, Vol. XXVII, p. 361.

1835. **Microlite.** Chesterfield.

Octahedral tungstic baryte.

Full description and figures, O, ∞ O, O, 2 O 2. Its chief ingredient is probably the oxide of cerium. Largest crystals, 0.4 gr.

C. U. Shepard: Min., Part II, Vol. II, p. 45.

1837. **Microlite.**

Analysis.

CbO	75.70
CaO	14.84
WO_3 YO UO	7.42
HO	2.04
	100.00

C. U. Shepard: Chemical examination of microlite; Am. Jour. Sci., 1st series, Vol. XXXII, p. 338.

1841. **Microlite.** Chesterfield.

A new mineral, chiefly an oxide of cerium.

E. Hitchcock: Geol. Mass., p. 704.

1842. **Pyrochlore.** Chesterfield.

Transparent straw-yellow to brick-red and black, the transparent and smaller crystals being beautifully modified.

Analysis by A. A. Hayes:

TiO_2	80.0
SnO FeO CeO UO	11.8
CaO	8.2
	100.00

J. E. Teschemacher and A. A. Hayes: On the identity of pyrochlore with the microlite of Professor Shepard; Am. Jour. Sci., 1st series, Vol. XLIII, p. 33.

1842. **Microlite.** Chesterfield.

Maintains the species microlite and gives chemical proof that it is a columbate of lime and yttria.

C. U. Shepard: Want of identity between microlite and pyrochlore; Am. Jour. Sci., 1st series, Vol. XLIII, p. 116.

1844. **Pyrochlore.**

"The close examination of above 200 crystals of the mineral named microlite by Professor Shepard * * * indicated to me in 1841 the complete identity of the mineral with pyrochlore. This identity, strenuously resisted by Professor Shepard, though on grounds which show a very superficial acquaintance with the whole subject, has been completely proved by subsequent analyses, particularly by that of A. A. Hayes (Am. Jour. Sci., 1st series, Vol. XXXII, p. 341), and its station as a columbate of lime, according to one of Shepard's analyses, confirmed. My largest crystal is three-eighths of an inch at base of pyramid."

J. E. Teschemacher: Bost. Jour. Nat. Hist., Vol. IV, p. 501; Philos. Mag. of London, Edinburgh, and Dublin, 1844.

1844. **Microlite?.** Chesterfield.

Mr. Teschemacher has called my attention to some minute transparent yellow and highly brilliant crystals which, with columbite and microlite, are found in the Chesterfield granite. They have the characters of a columbite, but differ from true microlite. Mr. Teschemacher has a crystal of microlite much modified by an uranium mineral crystallized with it. Generally the yellow stains on the albite are the most marked indications of the existence of microlite crystals.

Note: A. A. Hayes; Am. Jour. Sci., 1st series, Vol. XLVI, p. 159.

1844. **Microlite.** Chesterfield.

Acknowledges error in calling the mineral a titanate in previous analysis and communicates new analysis of microlite and of the foreign pyrochlore, from which he concludes that they are the same mineral.

A. A. Hayes: Reexamination of microlite and pyrochlore; ibid., p. 158.

1845. **Microlite.** Chesterfield.

Maintains its identity with pyrochlore and explains the specific gravity by the greater quantity of columbic acid, 80 per cent, as against 53 per cent in pyrochlore.

J. E. Teschemacher: Am. Jour. Sci., 1st series, Vol. XLVIII, p. 395.

1845. **Microlite.** Chesterfield.

"The dimensions of the controversy to which this little mineral has already given rise seem half entitled to place it under gigantolite." In answer to Hayes's chemical reexamination of the mineral and interpretation of his (Shepard's) results, Shepard quotes Berzelius's Report of Progress, where he concludes from the researches published that the mineral is only a yellow yttro-tantalite. Shepard concludes that "the whole mineralogical question then—if there still be any—comes back to the point where I had left it, viz, to the difference in regard to gravities. Pyrochlore has a gravity of 4.20 to 4.32; microlite, 5.48 to 5.646. As soon as Mr. Teschemacher with his 200 crystals (which is a twenty-fold greater number than I have had the good fortune to see) shall by simple observation with the balance cause this discrepancy to disappear, etc., then the species will disappear."

C. U. Shepard: Ibid., p. 177.

1852. **Microlite.** Chesterfield.

Description.

C. U. Shepard: Min., 3d ed., p. 248.

1868. **Microlite.** Chesterfield.

From blowpipe investigation suggested by Brush to be probably a pyrochlore in which tantalic acid replaces the columbic, this corresponding with the high specific gravity and larger percentage of the metallic acid. (?) $[CaO,MnO]TaO_6$.

J. D. Dana: Min., p. 514.

1892. **Microlite.** Chesterfield.

E. S. Dana: Min., p. 728.

MOLYBDENITE.

1818. **Molybdena.** Shutesbury, on land of William Eaton.

Crystals flat six-sided prisms 1 inch or more in length; in ledge 6 to 7 feet above surface of earth, 10 to 12 feet above water.

E. Silliman: Not. of Min. Loc.; Am. Jour. Sci., 1st series, Vol. I, p. 238.

1819. **Sulphuret of molybdena.** Brimfield.

In granite traversing gneiss; very common.

A. Eaton: Min. Loc.; ibid, Vol. II, p. 238.

1820. **Sulphuret of molybdena.** West Brimfield.

Granite, discovered by Dr. A. Lincoln.

A. Eaton: Index, p. 94.

1822. **Molybdena.** Middlefield.

In actynote and steatite.

C. Dewey: Min. Loc.; Am. Jour. Sci., 1st series, Vol. V, p. 268.

1823. **Sulphuret of molybdena.** Brimfield (Eaton).

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 235.

1824. **Molybdenite.** Chesterfield.

Dr. J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 58.

1824. **Sulphuret of molybdena.** Chesterfield.

Six-sided prisms in quartz.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 58.

1825. **Molybdena.** Goshen.

In granite.

J. Porter: Min. Loc.; ibid., Vol. IX, p. 55.

1825. **Molybdenite.** Chesterfield, Goshen, Middlefield

In actinolite and steatite.

Robinson's Cat., pp. 43, 51, 59.

1828. **Molybdena.** Shutesbury.

"Went in search of location mentioned in American Journal of Science (1st series, Vol. I), on land of William Eaton; could not find any such person nor ascertain that he ever owned land in that place, though he was recollected. Ascertained at length that the spot was on land of Mr. Pratt, in the extreme northern part of the town, close by a common chalybeate spring. In granite in mica-slate. Few specimens to be obtained without blasting."

E. Hitchcock: Min. Ex.; Am. Jour. Sci., 1st series, Vol. XIV, p. 217.

1835. **Molybdenite.** Shutesbury.

Figured.

C. U. Shepard: Min., Part II, Vol. II, p. 52.

1835. **Sulphuret of molybdenum.**

Said to have been found in Middlefield steatite.

E. Hitchcock: Geol. Mass., p. 363.

1838. **Sulphuret of molybdenum.** Brimfield.

With iolite, 1½ miles northeast of village, land of Samuel Patrick. Abundant in dots.

J. W. Foster: Am. Jour. Sci., 1st series, Vol. XXXIII, p. 400.

1841. **Sulphuret of molybdenum.**

Shutesbury; Lock's Pond: In hexagonal plates nearly an inch in diameter in gneiss.

In bowlder in gneiss in Pelham, Middlefield.

E. Hitchcock: Geol. Mass , pp. 613, 637.

1844. **Molybdenite.** (*Elasmites hexagonus.*) Shutesbury.

J. D. Dana: Sys. Min., p. 500.

(I have not been able to verify any of the above localities except that at Shutesbury. The Brimfield iolite occurs in small granite veins in the highly graphitic Brimfield schist. I have not been able to find molybdenite at the locality, and probably graphite was mistaken for it.)

1894. **Molybdenite.** Chester.

In vein in chloritic hornblende-schist with pale-green epidote from the upper portion of the main shaft at the emery mine.

In distinct tabular crystals, apparently P, 0 P, ∞ P. P striated; 0 P depressed to a regular six-faced, hopper-shaped cavity, suggesting the idea that it may be a twinned crystal in the rhombic system.

MONTMORILLONITE.

1825. **Carbonate of manganese.** Goshen.

The spodumene is almost uniformly invested with a very thin coating of carbonate of manganese; in the interior pulverulent and delicate rose-red; at the surface brownish-black.

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 607.

1876. **Quincite.** Goshen.

C. U Shepard: Cat. of Min. within 75 miles of Amherst College.

This refers, as specimens in the Shepard collection with the author's label showed, to the pink coloring films upon the altered spodumene. I know no evidence except color which could cause one to assign the substance to the limestone mineral quincite, and I prefer to follow Dana and Brush in assigning it to montmorillonite.

1879. **Montmorillonite.** Norwich (now Huntington).

"By the deposit of a pink substance at Norwich acting as a characteristic coloring film upon spodumene."

A. A. Julien: Spodumene and its alterations; Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 326.

1886. **Montmorillonite.** Southampton.

In thin, pink, botryoidal crusts at the Loudville lead mine on decomposed granite.

1891. **Montmorillonite.** Belchertown.

Similar crusts upon the fissures in the mixture of granite and hornblende schist at Kellys Crossing.

MUSCOVITE.

1818. **Mica.**

Abundant east of the Connecticut River. In crystals in Amherst.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 113.

1820. **Mica.** Chester or Westfield.

Hexagonal crystals in granite.

Chester Dewey: Loc. Min.; ibid., Vol. II, p. 237.

1823. **Mica.**

Cummington and Plainfield, green; Williamsburg, white and yellowish, abundant.

J. Porter: Loc. Min.; ibid., Vol. VI, p. 248.

1823. **Mica.**

Leverett; laminated, lamellar. Goshen, yellowish-green and violet, and sometimes in rhombic tables (Gibbs).

Most of the mica in the granite veins in Conway, Ashfield, Williamsburg, Chesterfield, etc., is straw-yellow, sometimes rose-red, and in these veins it exists in excess. It occurs in these and other towns, also in granite and of a smoky or nearly black color.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 220.

1824. **Prismatic and tabular mica.** Norwich (Huntington).

Abundant and very beautiful at White Rocks, one-half mile west of and visible from Pitchers Ridge. In coarse granite.

E. Emmons: Ibid., Vol. VII, p. 254.

1824. **Prismatic mica.** Chesterfield and Goshen.

Abundant.

J. Porter: Min. Loc.; ibid., Vol. VII, p. 253.

1824. **Mica, prismatic.** Chester.

Fibrous, very fine, passing into prisms; also Worthington; Williamsburg, plumose.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 41.

1825. **Mica.** Goshen.

Green, rose, and silver colored; also beautiful white talc, which I believe has not been credited to this locality (= cymatolite).

E. Hitchcock: Min. Loc.; ibid., Vol. IX, p. 21.

1827. **Plumose mica.** Williamsburg.

Six inches long.

A. Nash: Lead mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 260.

1835. **Plumose mica.** Williamsburg; several places west and northwest of the village.

E. Hitchcock: Geol. Mass., p. 504.

1841. **Mica.**

Chesterfield and Goshen; rose-red, delicate yellow, transparent, and silver. Northwest of Norwich, nearly 2 feet in diameter. Prismatic mica in Goshen, Chesterfield, Norwich, Leverett; best at Russell. Plumose mica in Williamsburg west and northwest of village.

E. Hitchcock: Final Report, p. 701.

1846. **Damourite.** Chesterfield.

Yellow, amorphous; found in very small quantity; gives off water, becomes milk-white. Before the blowpipe melts with great difficulty into white enamel, colorless bead, blue with cobalt. Silica, alumina, with little potash. In recesses in the albite and seems to have undergone strong pressure.

Teschemacher: Proc. Bost. Soc. Nat. Hist., Vol. II, p. 107.

1857. **Mica.** Chesterfield.

The rose-colored mica contains:

K_2O	9.08
Na_2O	.99
Li_2O	.64
H_2Fl	1.89

Angle of optic axes, 74.76.

J. W. Mallet: Am. Jour. Sci., 2d series, Vol. XXIII, p. 180.

1879. **Muscovite pseudomorphs after spodumene.** Chesterfield Hollow. Goshen, Barras farm.

"Many pseudomorphs were found in the Chesterfield vein which consist in large part or entirely of a greenish-yellow muscovite of a peculiar greasy luster. In fact all stages of admixture with cymatolite were observed from the almost pure pseudomorphs of the latter mineral, in which muscovite occurred only in minute or even in microscopical scales, lying mostly parallel to the axis of the crystals—to others in which the mica was so abundant as to have imparted a yellow or greenish color to the mixture and at last to micaceous pseudomorphs, perfectly free from cymatolite. All these varieties of intermixture appear to be rather the results of intercrystallization than of alteration of either one of the pseudomorphous minerals into the other. In another form the pseudomorph in albitic granite graduates into pure muscovite in irregular granular arrangement, producing prisms of great size. At the Barras farm 'aglaite' and muscovite are intercrystallized in similar ways. The change of spodumene into muscovite seems to consist in an exchange of alkalies and removal of $2SiO_2$ from the molecule of spodumene."

A. A. Julien: Spodumene and its alterations; Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 347.

1879. **Killinite.** Chesterfield, Huntington.

"Found frequently, but in limited quantities, at Chesterfield Hollow, and quite rarely in the Huntington vein."

It occupies the entire core of some of the smaller cymatolite pseudomorphs after spodumene, but ordinarily appears as a layer between it and the outer crust of cymatolite (q. v.). Texture foliated; H. = 3.5; luster dull and greasy; color greenish-gray to olive-green. Under the microscope the straight parallel fibers of killinite are continued in the curved needles

1879. Killinite—Continued.

and blades of the cymatolite. From the analysis below is deduced the formula for killinite: $H_2K_2Al_2Si_5O_{18}$ + 2 aq. which is derived from the doubled molecules of spodumene ($Li_4Al_2Si_8O_{24}$), by the replacement of Li_4 by (H_2K_2), the removal of ($3SiO_2$), and the addition of ($2H_2O$), and this change is assumed to have been caused by "meteoric alteration," by surface waters charged with organic acids and their ammoniacal salts combined with potassa derived from the orthoclase, and to be subsequent to the formation of cymatolite.

SiO_2	46.80
Al_2O_3	32.50
FeO	2.33
MnO	.04
CoO	.04
MgO	.48
CaO	.77
Li_2O	.32
Na_2O	.78
K_2O	7.24
H_2O	7.66
Nitrogenous organic matter	1.14
	100.12

A. A. Julien: Spodumene and its alterations; Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 354.

1880. Killinite.

Proved to be probably a hydrous muscovite, or sericite.

G. J. Brush and E. S. Dana: The spodumene of Branchville; Am. Jour. Sci., 3d series, Vol. XX, p. 274.

(In view of the results reached by Brush and Dana in the paper above, we may call attention to the close similarity—chemically—of killinite and muscovite and the greater simplicity of the explanation suggested by Professor Julien (p. 349) for the change of spodumene into muscovite—the separation of ($2SiO_2$) from a molecule of spodumene—as compared with the explanation quoted above for the change of spodumene to killinite.

It is more interesting to see that the two explanations are in essence almost identical, and since the last-quoted explanation is based on an elaborate discussion of a single analysis of a substance which is probably a mixture, I think we are justified in accepting the simpler and extending it somewhat more than the author does to cover the change of spodumene to "killinite" as well as to the coarsely crystalline muscovite.

Killinite is thus the cryptocrystalline representative of the mica pseudomorph as cymatolite is of the granitic.)

1880. Mica. Hampden County.

Number of mines	1
Capital	$5,000
Workmen	25
Wages	$750
Explosives	$600
Product, pounds	1,000
Product, value	$1,250

Tenth Census, 1880, Vol. XV, pp. 843, 851, 852.

On page 851 the product is given as 1,000 tons. This refers to the mine of the Pontoosuc flint mills, situated on the mountain south of their mills and in the town of Blandford.

1881. **Muscovite.** Williamsburg.

"Plumose mica abounds on what is known here as Gear Hill, about 1 mile northwest, near the hamlet called Searsville. I have found it plentiful there for some sixty years, and have supposed it the best locality known; found only within the circuit of a few hundred acres."

Morris Dwight (letter to the author).

1882. **Muscovite.** Goshen.

I have found pseudomorphs of muscovite after spodumene on the north shore of Lily Pond, in the northwest of Goshen.

1883. **Muscovite after microcline.** Amherst.

West of middle of long dike east of North Amherst.

Muscovite, white, developed on the cleavages 0, 'P', $\acute{\infty} P \bar{\infty}$, $\infty P \breve{\infty}$, of nodules of microcline until it nearly takes its place.

1886. **Muscovite.** Monson. Flynt's quarry, east side.

In imperfectly bounded crystals up to 8 inches square; cleavage planes occupied by a twinned network of flattened crystals of magnetite, as in the muscovite of Pennsbury, Pa. The pattern is here finer and more delicate, and there is always a free border one-half inch wide in the muscovite which is free from the magnetite. The crystals occur in the upper edge of a small pegmatite dike which penetrates the gneiss from below and comes to its upper limit in the middle height of the quarry.

1886. **Muscovite.**

The "lithionglimmer" of Chesterfield and other North American localities contains stannic acid.

F. Sandberger: Untersuchungen über Erzgänge, p. 191.

1891. **Muscovite.** Russell.

In columnar crystals.

C. Hinze: Min., p. 629.

NATROLITE.

1818. **Zeolite.** Deerfield.

Rare, radiated.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1823. **Zeolite.**

Radiated fibrous masses sometimes as large as a musket ball, or, more rarely, an inch in diameter.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 224.

1824. **Fibrous zeolite.** Chester.

Associated with prehnite in fibrous masses (Emmons).

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 45.

1841. **Thomsonite.**

In the amygdaloid on the east side of the greenstone range in Deerfield and Greenfield; a few rather poorly characterized radiated specimens exceedingly resembling the thomsonite of Scotland.

E. Hitchcock: Geol. Mass., p. 662.

1882. **Natrolite.** Deerfield.

This mineral occurs in loose tufts of very minute needles 0.01 to 0.004 mm. in diameter, coating prehnite, especially in those specimens where epidote was abundant. It was not found associated with datolite or any of the succeeding minerals. The needles were colorless when fresh, but large pieces of rock were thickly covered with brown tufts of apparently the same mineral, which gave a black bead with the blowpipe and seemed to be nearly transformed into limonite.

1882. **Natrolite**—Continued.

The natrolite is succeeded in the prehnite-epidote veins only by calcite, acute scalenohedra inclosing whole tufts of the former mineral, and by fluorite, which is speared upon the delicate needles of the natrolite in minute, transparent, colorless octahedra, pierced through a hexahedral axis. From one to four of these are strung upon a single needle, often at the very tip, and in one field of the microscope (× 40) I counted seventeen; and the whole, having as a background the deep-green polished faces of the epidote crystals upon which the group rested, made an object of great beauty. It undergoes also an extremely peculiar alteration into saponite, and further appears in hollow pseudomorphs apparently of saponite—acute prisms resembling epistilbite.

B. K. Emerson: Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXVI, p. 355.

1882. **Natrolite.** South Hadley.

Following up Dry Brook in the northwest of South Hadley to the point where it runs on the line of contact of sandstone on trap, the latter is coarsely amygdaloidal and the cavities are filled with radiated natrolite which make exquisite preparations for the microscope.

1891. **Natrolite.** Buckland, near Shelburne Falls.

In quarry on railroad in white gneiss. Tufts of white needles. Very rare. Associated with axinite.

NEPHRITE (?).

1824. **Jade** (subspecies of nephrite). On Westfield River.

Very tenacious; scratches quartz; of pale-green oily aspect; fragments splintery and fracture dull; rare (Emmons).

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 43.

(This can not be identified. It is possibly a green hornstone or silicified serpentine from the Middlefield bed.)

OLIGOCLASE.

1865. **Amphodelite.** Chester.

The diaspore is associated with rose-colored amphodelite.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 112.

1865. **Indianite.** Chester.

"A vein of indianite many inches thick is found near the tunnel in South Mountain running for many rods through the chloritic rock on the east side of the emery vein (exterior to its gneissoid wall). This chloritic seam is called by the workmen 'the fringe rock.' Small particles of the corundum are diffused through the indianite."

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XL, p. 123.

1866. **Andesine.** Chester.

The rock originally mistaken by me for granular quartz and called indianite by Shepard proves on analysis to be andesine, although it is harder than stated in the books, scratching quartz easily. It is associated with crystals of black tourmaline; compact, fine granular. Sp. gr. 2.586; H. 7.5; color slightly greenish-white.

1866. **Andesine**—Continued.

Analysis.

	No. 1.	No. 2.
SiO_2	62.00	60.00
Al_2O_3	24.40	25.00
CaO	3.50	....
MgO	.70	....
Na_2O	8.07	....
H_2O	1.00	....
	99.67	....

C. T. Jackson: Analysis of seven minerals from the emery mine of Chester; Am. Jour. Sci., 2d series, Vol. XLII, p. 107.

1868. **Indianite.** Chester.

Exterior to the vein on its eastern side, a few feet within the talcose slate on South Mountain, near Deerfield River, is a layer 6 inches to 2 feet thick called locally "the fringe rock." Through the middle runs a vein of indianite 2 to 10 inches; massive, fine granular, yellowish; contains corundum.

C. U. Shepard: Report of the Chester emery mine.

The mineral shows all the optical properties of oligoclase.

1887. **Oligoclase.** Palmer; bowlder at house of R. Printible.

In bowlders of coarse hornblende biotite gneiss; large masses 1 to 2 dm. across of a curious very fresh feldspar; color shading from white to pitch black, in large patches. Marked conchoidal fracture and glassy luster, and tabular parting rudely parallel to a prism face. Rarely a brilliant basal cleavage without pearly luster and with fine twin striation; color due to parallel microscopic needles exactly like those in labradorite; sp. gr. 2.63; extinction, $2^\circ 48'$ on $0 P$. Traces of play of colors on $\infty P \breve{\infty}$.

Analysis by G. H. Corey, class of 1888, Amherst College:

SiO_2	64.74
Al_2O_3	22.48
CaO	4.54
Na_2O	7.84
K_2O	.26
	99.86

This equals 6 Ab: 1 An.

OPAL.

1821. **Stalactitical quartz.** Cummington.

J. Porter: Am. Jour. Sci., 1st series, Vol. VI, p. 247.

1821. **Opal, Hyalite.** Middlefield, Worthington.

Dirty-brown.

Robinson's Cat., pp. 59–78.

1823. **Opal.** Middlefield (Emmons).

J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VI, p. 248.

1824. **Siliceous sinter, hyalite.**

In serpentine in Middlefield (Emmons); sometimes nearly stalactitical (Porter); dirty-brown, coarse, ferruginous in Middlefield; reddish-brown with whitish spots (Emmons).

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 39.

1841. **Hydrate of silica.** Pelham.

E. Hitchcock: Geol. Mass., p. 99.

1876. **Opalite.** Variety of *hyalin.* Monson and Greenfield.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 5.

1881. **Hyalite.** Monson, Pelham.

Monson. Delicate chrysocolla green to colorless layers on gneiss and hornblendic gneiss at Flynt's quarry.

Pelham. In colorless layers, botryoidal, on gneiss in quarry above bridge over Amethyst Brook.

1882. **Hyalite.** Greenfield.

A colorless hyalite of fine botryoidal structure covers, with a thick layer, broad surfaces in the dark-gray diabase from the cuttings for the new road from Greenfield to Turners Falls, where also pearly white botryoidal layers are very abundant and seem in many cases to be of very recent origin, and to have coated minute rootlets, which had penetrated the fissures and lay across the botryoidal surface.

B. K. Emerson: Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 355.

1883. **Opal.**

Large bowlders in Amherst, probably from Conway, highly ferruginous and full of small balls of limonite and show drusy chalcedonic surfaces.

Heated thirty hours with 20 per cent solution of KHO, only 46.61 per cent remained insoluble; loss by ignition, 2.94. The citations of the Conway locality are given under Quartz.

1883. **Hyalite after barite.** Leverett, eastern lead mine.

E. J. Whitaker, class of 1883, Amherst College.

ORTHOCLASE.

1820. **Adularia.** Brimfield.

In gneiss and granite. Nearly equal to that of the Alps. Near residence of the late Gen. William Eaton.

Am. Jour. Sci., Vol. V, p. 41; also Amos Eaton, Index, p. 94.

1832. **Adularia.** Brimfield, near center of town.

Greenish; used as a gem.

E. Hitchcock: Geol. Mass.; Am. Jour. Sci., 1st series, Vol. XXII, p. 50.

1838. **Adularia.** Brimfield, one-half mile northeast of village, Warren road, near house of Samuel Patrick.

With iolite; chatoyant; striated.

J. W. Foster: Am. Jour. Sci., 1st series, Vol. XXXIII, p. 399.

1883. **Adularia.** West Northfield.

In minute simple crystals ∞P, $0 P$, $2 \breve{\infty}$, in drusy surfaces and in larger crystals up to 8 mm., deeply corroded on prism face parallel to the vertical axis, associated with radiated cleavelandite. On Devonian quartzose mica-schist at end of clearing, southwest of South Vernon.

1887. **Orthoclase** var. moonstone. Brimfield, Monson, east part; Wales, Holland.

The fresh transparent feldspar cited above as adularia agrees exactly with the moonstone of Ceylon. It occurs in small lenticular inclosures in the Brimfield schist. Quite large cleavage pieces can be obtained which are wholly free from fissures, and with fine opaline luster. The extinction on 0 P is 0.

1895. **Orthoclase.** Var. **Chesterlite.** Warwick.

Small flesh-colored crystals, ¼ mm. across, in druses in the epidote-garnet rock. South of the village. ∞ P, 0 P, P $\bar{\infty}$.

OTTRELITE.

See Chloritoid (1865) and Biotite (1852).

PELHAMINE.

See Chrysolite (1876).

PELHAMITE.

See Chrysolite (1876) and Jefferisite (1875).

Pelhamite of Cooke 1875 (= jefferisite) antedates pelhamine of Shepard 1876, which is the least altered form of an eruptive rock. Both words should be retired to the list of synonyms.

PETALITE (?) or SCAPOLITE.

1841. **Petalite (?) or scapolite.** Westfield.

In serpentine in a vein nearly a foot wide.

E. Hitchcock: Geol. Mass., p. 618.

(Probably refers to the enstatite bed at Munn's Brook. See p. 77.)

PHENAKITE.

See Beryl, 1838.

PHLOGOPITE.

1885. **Phlogopite.** Middlefield.

In the pre-Cambrian limestone in the railroad cutting on Coles Brook, in small yellow and bronzy scales.

PHOSGENITE.

See Anglesite.

PHYLLITE.

See Biotite.

PIHLITE.

1868. **Pihlite.**

See Cymatolite (1868).

PIMELITE.

1825. **Pimelite.** Middlefield.

"In the neighborhood of the spot where the crystallized steatite is found Dr. Emmons and myself discovered very beautiful pimelite. It occurs in serpentine. It possesses a very deep apple-green color, is very pliable, and when first broken from a cavity is greasy to the touch."

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 609.

(This is not again cited by Professor Shepard.)

1826. **Pimelite.** (Nickel coloring clay.) Middlefield.

Small quantities in cavities in stalactitical quartz; color fine grass-green. The masses when first broken present a granular structure; when dry, become compact and full of cracks and fissures; in quartz connected with serpentine.

E. Emmons: Min. Not.; Am. Jour. Sci., 1st series, Vol. X, p. 11.

The two citations are interesting as showing that the localities of "stalactitical quartz," (that is, the yellow chalcedony of Chester) and the "crystallized steatite" (that is, the olivine pseudomorph in serpentine) are near together, probably in the brook bed crossing the serpentine near its base.

PINITE.

1825. **Pinite.** Chester.

Generally amorphous; in granite traversing mica-slate, one large crystal obtained measuring 2½ inches in diameter; not abundant.

E. Emmons: Min. Loc.; Am. Jour. Sci., 1st series, Vol. X, p. 11.

1841. **Pinite.** Chester (Emmons's Mineralogy).

E. Hitchcock: Geol. Mass., p. 605.

PLATINUM?

1838. **Platinum?**

Dr. H. Holland thought he obtained a trace of platinum from Chester chromite.

E. Hitchcock: Econ. Geol., p. 125.

PREHNITE.

1818. **Prehnite.** Deerfield.

In greenstone, incrusting the columns in radiated masses, rarely crystallized; veins nearly perpendicular.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1823. **Prehnite.** Deerfield, Greenfield, etc.

In Deerfield radiated masses sometimes contain pyritous copper which occurs also on pseudomorphous quartz, and has evidently been formed since the decomposition of the crystals originally occupying the cavities; also on chalcedony.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 223.

1824. **Prehnite.** West Springfield.

In secondary greenstone, in radiated masses.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 45.

1825. **Prehnite.** West Springfield.

In greenstone; in green radiating fibers, decaying; poor.

Emerson Davis: Min. Not.; ibid., Vol. IX, p. 252.

1825. **Prehnite.** Greenfield.

In greenstone (Hall).

Robinson's Cat., p. 52.

1835. **Prehnite.** Turners Falls, on Greenfield side.

Nearly white; more common on eastern side of greenstone ridges. Example: Mouth of Deerfield River and 4 to 5 miles south at Pine Nook in Deerfield; in West Springfield no very rich specimens.

E. Hitchcock: Geol. Mass., p. 434.

1841. **Prehnite.** Belchertown, in gneiss; Three Rivers.
E. Hitchcock: Final Report, p. 639.
(Should be Palmer.)

1841. **Prehnite.** Greenfield, West Springfield.

Common in amygdaloid; color nearly white; more common on eastern side of ridge than western. Examples: Notch of Deerfield River, on east side of same ridge, 4 to 5 miles south at Pine Nook; also West Springfield on west side of ridge; also 1 mile east of Deerfield church, and 1 mile east of Greenfield. Finest specimens at cutting of Western Railroad in West Springfield. The balls of radiated prehnite here occupy veins in the rock along with calcareous spar, which often invests the prehnite with minute crystals. (This last locality is the Tatham cut in the posterior trap. Specimens preserved in the State collection at Amherst.)
E. Hitchcock: Geol. Mass., p. 661.

1859. **Prehnite.** Three Rivers, Palmer.
"On gneiss."
E. Hitchcock; ibid., p. liv.
(Nearly perfect discs with slightly bulging faces and milled edges like a thick coin. Specimen in the State collection at Amherst.)

1859. **Prehnite.** West Springfield.
"On greenstone."
E. Hitchcock: Cat. State Col., Agr. Rep. Mass., app., p. lvii.

1882. **Prehnite.** Pelham.

Ward's quarry on joint in Pelham gneiss. In minute, flat, blade-like crystals $0 P, \infty P, \infty P \breve{\infty}$, pale mountain green, often slightly covered with rust layer; in stout crystals 5 mm. to 6 mm. long with same faces or only $0 P, \infty P$; ∞P is curved and 0 slightly rounded; same color. The latter form is in single crystals and not twinned as in the trap prehnite from Deerfield, as it polarizes simply. Paragenesis:

Gneiss,
Quartz,
Epidote,
Prehnite,
Scolecite,
Pyrite,
Kaolin,
Limonite.

Found by H. A. Smith and others of class of '83, Amherst College.

1882. **Prehnite.** Deerfield. At Cheapside, south of the river.
In fissures.

Prehnite occurs here most abundantly and always as the oldest mineral in the veins in which it appears. That the veins where it is absent have been filled at a later period and at a lower temperature is evident from the fact that in these the vein walls are quite as fresh as the body of the rock, while in the prehnite veins the walls are deeply decomposed, often to a depth of several centimeters into a rusty vesicular mass, which has been filled with massive prehnite, forming a rock nearly as compact as the trap itself. Similarly many detached fragments of the trap have been thoroughly decomposed and in the same way filled with massive prehnite. Under the microscope the mineral is here seen to be made up of fibers variously matted and interlaced and intermingled with the remains of the trap, and much of it exactly resembles chlorastrolite. In other specimens the oldest layer of the mineral is jet-black to deep oil green, polished and

1882. Prehnite—Continued.

often slickensided and gashed, the color being due to the thorough impregnation of the prehnite with diabantite. The motion of the rock walls has also at times broken up the prehnite into sheets, which are slipped over each other variously and recemented by prehnite. Wherever the mineral is hindered in its growth it shows a strong tendency to take on these fibrous forms, which seem to me to depend upon a greater energy of the crystallizing force in the direction of the long horizontal axis; upon which depends also the curvature of the faces so common in the species. Generally these fibers are quite large, peculiarly rigid, and in large numbers parallel to each other. In one slickensided piece the fibers of black prehnite, all straight and parallel and placed at a slight angle to the surface of the trap, seem as if combed into this position by the movement of the walls, and, being jet-black from inclosed diabantite, resemble in appearance seams of fibrous hornblende or chrysotile.

The fibers are, however, generally colorless, transparent, and of a high satiny luster on the face 0 P. They are apparently always elongated in the direction of the long horizontal axis and bounded by the planes 0 P, $\infty P\bar{\infty}$, $\infty P\breve{\infty}$. At times the satiny luster is reflected from a large group of the needles at once, and they are seen when magnified to be in juxtaposition, and forming each group for itself an aggregate crystal, the lines of junction being represented in the larger crystals by the striation parallel to the long axis. At times the little groups ran under each other, or joined at their ends under angles of 80° and 100°, as if there were some trace of twinning on ∞ P, as in the spindle-shaped crystals described later. It seemed like a model of the complex striation seen in the latter.

The prehnite also occurs in many drusy cavities covered with small distinct crystals, pale green, emerald green to yellow, and in delicate emerald-green "roses" produced by the multiple twinning of the same form 0 P, $\infty P\bar{\infty}$, $\infty P\breve{\infty}$, and in stout, square prisms with base and two sides convex, the two remaining sides concave. The more common botryoidal forms are scarcely represented.

By far the most abundant, finely crystallized, and peculiar form is a stout double cone or spindle, the two cones joining directly base to base with an angle of 80°, or separated by a cylindrical plane, which may become as wide as the conical faces by which it is bounded; rarely this face is replaced by a reëntrant angle of 41°. These three faces are physically unlike, the two sloping ones being sometimes smooth and polished, at others mosaic-like, the equatorial plane being oftentimes milled as regularly as a coin by the oscillatory repetition of ∞ P and $\infty P\breve{\infty}$, and finally the conical faces become rarely convex in the direction from the apex to the base, producing small, globular forms. These cones are laid usually with their axes parallel to the surface on which they rest—the axes pointing in all directions in this plane—and fused together so that only a fraction of each one is distinct, though they often stand out so that half or three-quarters of the circumference is visible, and in this way completely cover broad surfaces with a splendid crystallization. In color they range from white and nearly pellucid to pale celandine green, and rarely to pale rose color, in the smaller spindles with polished sides, to deep, clear apple green in the largest cones; and in other forms with very broad cylindrical faces, deep mountain green. Several pieces a foot square were obtained covered with the finest crystals. In a single instance the crystals of this form have spread over calcite, and, this having been removed, they presented a group of scarcely adhering individuals, the segments of cones bounded below by a single saddle-shaped face.

1882. Prehnite—Continued.

The internal structure of these crystals is quite peculiar. The pearly basal cleavage passes inward in the direction of a vertical section of the cone, and plates cut in this direction and continued down into the trap show the fibrous prehnite at the base felted together with much decomposed trap, above growing purer and forming distinct crystals with doubly striated cleavage faces, which are twinned along a distinct suture and bounded outwardly by irregular planes of contact. After each crystal has risen above the general level to form the segment of a double cone, the suture forks with an angle of about 41°, and the two lines run to meet the angles formed by the meeting of the two conical faces with the central zone. Each of the spindles is thus made up of three crystals, one on either side of and one within the angle of the Y-shaped suture.

The shaded portion of fig. 2 represents such a vertical section, in which $D\,o'$ and $D\,o''$ ($= \infty\ P\ \bar{\infty}$) are the sections of the two conical faces and $o'\,o''$ ($= \infty\ P\ \breve{\infty}$) that of the central cylindrical face.

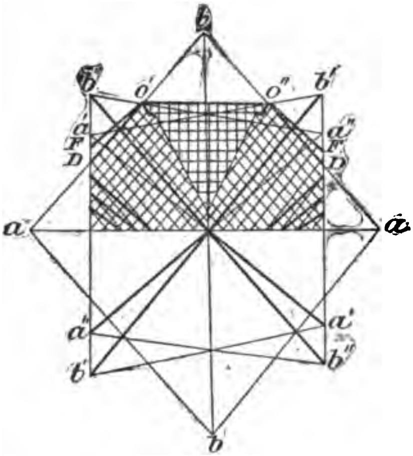

Fig. 2.—Prehnite; cross-section of twins.

The relations of the three crystals are made clear by fig. 2. Three superimposed prisms, ∞ P, having the base 0 P in common are revolved on the common vertical axis c to right and left until a prism face of each becomes parallel to the long horizontal axis of the third. Thus the two lateral crystals form an arrow-headed twin with a face of ∞ P in common, and are twinned against the middle one so that the same face ∞ P in each is parallel with $\infty\, P\, \bar{\infty}$ of the latter. If now the obtuse angle of the two lateral forms be truncated by $\infty\, P\, \bar{\infty}$ and that of the central one by $\infty\ P\ \breve{\infty}$ down to their point of contact o' and o'', a plane, marked with a heavier line in the figure, results, by whose revolution on the short axis a-a the spindle-shaped twin would be formed. The central crystal has the form of a triangular belt fitted into a similar groove upon the circumference of a wheel. An inspection of the figure will show that the arrow-headed twin, if formed by the union of two crystals having only the faces ∞ P and $\infty\, P\, \bar{\infty}$, would leave for the third crystal only an extremely shallow reëntrant angle of 160°, whereas the latter penetrates between the two in an angle of about 41°. This is because the acute angles of the lateral crystals are each replaced by the form $\infty\ P\ \breve{3}$, giving a reëntrant angle of 43° 17′. The

1882. **Prehnite**—Continued.

approximated faces of this form are alone strongly developed and make a trumpet-shaped cavity for the reception of the wedge. The curved basal face in the free crystals mentioned above were formed by the blunt point of the arrowhead and by the corresponding faces of $\infty P \breve{3}$ on the outer acute angles below at a'' and a'. The tendency of the mineral to form these strange triplets seems to depend upon the greater intensity of the crystallizing force in the direction of the long horizontal axis, so that of the many crystals which start in the fibrous base only a few survive and grow up into the free space by preponderating additions to the face $\infty P \breve{\infty}$ at right angles to the long axis, and are soon twinned so as to allow a third crystal to wedge in between them and grow by the development of the same face. All three grow thus predominantly in the same direction and expose and add to only the single crystalline face, and the crystal expands in growing like the top of a growing tree. The common vertical axis of the three crystals is bent thus into a circle.

When examined under the polarizing microscope, the central crystal, though showing a strong vertical and a faint horizontal striation, acts as a single crystal. The two flanking crystals present through a whole revolution under the nicols a complex latticework of brilliant colors with two predominant positions of maximum extinction, or rather of extinction of the greatest number of the narrow bands and wedges of color in the field, at angles of 40° and 50° on either side of the suture—that is, when parallel to the two sets of axes a' b$'$ and a'' b'' of the two lateral crystals. The narrow wedges of color often repeated many times, placed parallel to each other, extinguishing the light together, and bounded by lines making an angle of 10° with each other, are especially peculiar.

Of course the extinction of the light on the right hand of the suture parallel to the axis b' can alone be referred to the right-hand crystal, and the extinction at an angle of 10° with this and on the same side of the suture—that is, parallel to the axis a'' of the left-hand crystal—must be referred to this latter. So that the twin is not formed simply by the approximation of the two parts along the common suture plane, but by the interpenetration also of each by the other in narrow and, as it were, interwoven bands, as is represented schematically in the figure—much more regularly, of course, than in nature.

The two principal striations in each of the lateral prisms make an angle of 40° with the central suture—that is, an angle of 80° with each other.

It follows, taking the prism on the right (fig. 2) for example, that while one of these striations is parallel to the long axis b' of this prism, the other is parallel to the long axis b'' of the opposite, and in fact both striations seem in the plainest manner to be continuous as right lines across the suture.

Traces exist also, very faint indeed, of two other sets of striations at right angles, respectively, to those already described, which are identical with the delicate horizontal lining of the central crystal, and which combined with those first mentioned produce the long wedge-shaped blades with angle of 10° described above. This second striation is indicated in the lower portion of the shading in fig. 2. The phenomena here detailed would seem also to find their explanation in the interpenetration of the lateral prisms.

The similar twins of prehnite from Farmington, Conn., which occur in the same Triassic trap as the Deerfield crystals, were figured by M. Des Cloizeaux,[1] and have been recently the subject of discussion by the

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[1] Min., p. 451, Atlas XXIX, 167 bis, 1862.

1882. **Prehnite**—Continued.

same author[1] and by M. Mallard[2] because of their optical peculiarities. They do not seem from the descriptions to present the spindle shape, and in cross section they differ from the Deerfield crystals in one important particular.

In the Farmington crystals the sloping faces (*F* in fig. 2) make an angle of 100° with each other, and the termination of the crystal is thus bounded by a threefold repetition of the face $\infty P \breve{\infty}$, while in the Deerfield forms the corresponding angle of the two sloping faces measured over the single exposed face of the central crystal is 80° (*DbD*, fig. 2), and the three faces have the formulæ $\infty P \bar{\infty}$, $\infty P \breve{\infty}$, $\infty P \bar{\infty}$.

One may express the relation of the two very simply by saying that in the Farmington crystals the end of the arrowheaded angle twin having the reëntrant angle has its acute angles truncated by $\infty P \breve{\infty}$ to form the sloping sides, while in the Deerfield forms the other end is developed, and the outer obtuse angles truncated by $\infty P \bar{\infty}$, as in the annexed figure.

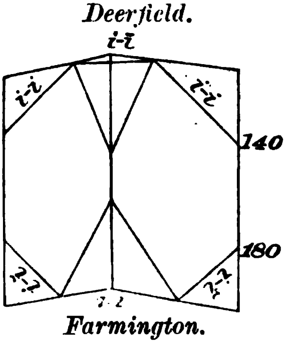

FIG. 3.—Prehnite; cross-section of twins: from fissures in Trassic diabase at Cheapside, Deerfield.

It seems to me simpler to say that the interpenetration of the two is so complex and at the same time so varying that in one case on the right of the suture the crystal which is turned to the right predominates and is truncated by $\infty P \breve{\infty}$ (*F* in fig. 2), at right angles to *b′*, and in the other that which is turned to the left predominates on the same (the right) side, and determines the truncation by $\infty P \bar{\infty}$ (*D* in fig. 2) at right angles to axis *a″*; while in the forms curved in the direction *o′ a*, and in those with faceted faces, there is a gradual or interrupted transition from one to the other.

This would also harmonize very well with the complex optical results detailed in the above papers, and especially with the dispersion tournante signalized by M. Des Cloizeaux for the Farmington crystals.

If the sloping faces in the Deerfield crystals, like those of Farmington, be referred to the acute angles of the arrowhead, to recur to the first explanation given above, they would have the more complex formula $\infty P \breve{6}\tfrac{1}{4}$. Furthermore, the two well-marked striations described above form by their intersections diamonds with the acute angles (80°) at top and bottom, while the larger angle is at the sides, while the drawing of M. Des Cloizeaux[3] shows the reverse to be the case in the crystals from Farmington.

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[1] Bull. Soc. Min., Vol. V, Nos. 2 and 5, 1882.

[2] Ibid., No. 3.

[3] Min.; ibid., loc. cit.

1882. **Prehnite**—Continued.

That is, in the first they are parallel to *b*′ and *b*″ (fig. 2), while in the second case, if they were exactly the reverse, they would be parallel to the short axes *a*′ and *a*″; but they are stated in the later article of M. Des Cloizeaux to make an angle not of 80°, but of 82°, with each other, so that while one is parallel to a short axis the other is parallel to a hypothetical face, ∞ P 6. If they made an angle of exactly 80° with each other, they would represent the horizontal striation of the central crystal and the faint second striation described in the Deerfield crystals, as slightly indicated at the bottom of fig. 2. As it is, they are difficult of explanation.

In amygdaloid cavities.—The amygdules of the trap quite closely repeat in miniature the occurrence of the large fissures, but the peculiar changes the prehnite undergoes in the former case makes it needful to discuss separately its modes of appearance there.

In the coarse diabase it occurs compact, of a bright green, as if colored by copper. The paragenesis is (1) diabantite; (2) chalcopyrite, pyrite, galena, prehnite, one or all; (3) calcite.

In the red diabase so abundant in the upper part of the dike through Greenfield and Gill it appears in spherical and spheroidal balls 12 to 15 mm. in diameter, very fine fibrous, and satiny, and very pale green to colorless; coated, and for a distance is impregnated with diabantite. It is radiated, fine fibrous, the fibers not easily separated, and diverging from several centers and meeting along sharp suture lines, so that only parts of spheres result, and if waterworn the grains would form perfect chlorastrolites.

In the dark-gray diabase from the north side of the Deerfield, and on through Greenfield and Gill, cavities 10 to 35 mm. across are sometimes filled with fibrous prehnite, the whole blackened as if it had been held in the flame of a candle. Under the microscope the fibers are, for the most part, perfectly fresh, and up through the spaces between them has penetrated a black amorphous powder looking like the beard of iron filings on a magnet, or like a network of soot-covered cobwebs. The whole seems to be dendritic in character.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 269.

1882. **Prehnite.** Bernardston.

Small compound crystals made up of several prisms surrounded by a dome and joined so as to make a form like a section of a thick saw blade, at the base of the upper quartzite of the Bernardston series; Williams farm.

1886. **Prehnite.** Northampton; at crossing of the Connecticut River Railroad, south of Mount Tom station.

In diabase; pale green, botryoidal.

1886. **Prehnite.** Northampton. At a quarry near W. N. Moore's, east of Florence.

In granite; a vein 10 mm. thick has on either wall quartz combs; on these broad sheets of finely crystallized prehnite, the crystals simple, 10 mm. long; forms 0 P (001), ∞ P (110), ∞ P $\bar{\infty}$ (100), ∞ P $\breve{\infty}$ (010); often rosetted by continuous twinning around the vertical axis. For paragenesis see monograph on the geology of the area.

1886. **Prehnite.** Prescott.

North part, roadside west of old cemetery, in fissures in diorite.

Pearly white, in drusy surfaces of minute plates like Des Cloizeaux, Pl. XXVIII, p. 165; $0 P$ (striated parallel to $\infty \bar{P} \infty$), ∞P, $\infty P \bar{\infty}$, $\infty P \breve{\infty}$, $3 P \breve{\infty} P$; plane of optical axes $\infty P \infty$; divergence 76°, positive; also covering broad surfaces with radiated fibrous circles 8 to 10 mm. in diameter, like wavellite, and in stout, fasciculate groups of crystals of forms like fig. 166 of the above plate, $0 P$, $\infty P \bar{\infty}$, $\infty P \breve{\infty}$, P (?).

An imperfect analysis made in the chemical laboratory of Amherst College gave results agreeing well with prehnite, except in the water determination. Mr. G. G. Pond, assistant in the laboratory, determined the water with care to 5.24, exactly that of prehnite.

1889. **Prehnite.** Monson.

In a vein in the northwest of Flynt's quarry; drusy surfaces of minute, transparent, colorless blades, $0 P$, $\infty P \breve{\infty}$, $\infty P \bar{\infty}$, ∞P, flattened on 0 and elongate parallel to *a*, as determined by fixing the position of the optical axes, associated with epidote, actinolite, and clinochlore, which it follows. It is covered by a transparent calcite and later fine green rosettes and barrel-shaped groups of prehnite with laumontite and calcite, shows the richest green color.

PROCHLORITE.

1823. **Chlorite.** Hawley and Plainfield.

Abundant and extremely beautiful.

J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VI, p. 248.

1823. **Chlorite.** Leyden and Conway, foliated. Millers Falls in Montague, penetrating milk-white quartz; New Salem.

E. Hitchcock: Geol. Conn. River; ibid., p. 228.

(The occurrence at Millers Falls is probably in bowlders, as the unaltered Triassic sandstones do not contain chlorite.)

1824. **Chlorite.** Middlefield and Chester.

In small masses; also in mica-slate (Emmons).

C. Dewey: Geol. Berkshire County; Am. Jour Sci., 1st series, Vol. VIII, p. 52.

1825. **Chlorite.** Zoar.

Abundant.

H. W. Wells: Robinson's Cat., p. 78.

1889. **Prochlorite.** Blandford, Whately, Northfield.

Occurs in quartz veins at contact of granite and hornblende schist near Bartholomew's quarry, in Blandford. In quartz veins in the argillite at Whately, and in the Devonian mica-schist in West Northfield. As a constant constituent of the sericite-schist across the whole width of the State. It is here largely derived from garnet.

PYCNITE.

See Topaz.

PYRITE.

1818. **Sulphuret of iron.** Charlemont and Deerfield.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 115.

1823. **Sulphuret of iron.** Hawley.

Small but beautiful crystals.

J. Porter: Min. Loc.; ibid., Vol. VI, p. 248.

1823. **Sulphuret of iron.** **(Pyrites. Iron pyrites.)** Bituminous shale.

Westfield, Sunderland, Plainfield, limpid quartz. Hawley, compact. Montague, with hematite. Southampton lead mine, fine crystals as large as shot; octahedrons truncated in all their angles.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 232.

1841. **Sulphuret of iron.**

In mica-slate. Heath, handsome cubic crystals. Hawley, massive, in considerable quantity near junction of mica and talcose slate. Loudville, small octahedra truncated on angles.

E. Hitchcock: Geol. Mass., pp. 607, 705.

1844. **Iron pyrites.** (*Pyrites cubicus.*) Hawley, Heath.

In handsome crystals.

J. D. Dana: Sys. Min., p. 479.

1884. **Pyrite.** Rowe.

Ore of Davis mine.

Fe, 42.83; S, 50.30; Cu, 3.07; granular.

G. Lunge: Dingl. Polyt. Jour., CCXLIX, p. 48.

1887. **Pyrite.** Heath.

The vein of iron pyrites on the old Chester Rice farm at Heath, now owned by J. W. Tinkham, has been distinctly traced, and is on the surface about 5 feet wide by about 12 feet in length. There is thought to be a rich mineral pocket beneath the indications.

Springfield Republican, 1887.

1891. **Pyrite.** Heath.

A ledge of rock thickly sprinkled with pyrites of iron 3 to 4 feet wide and 12 or more in length has been discovered in a ravine on the Tinkham farm. A small stream runs over the rocks, which when broken with a sledge disclose the pyrites, bright and shining.

Springfield Republican, February 24, 1891.

1891. **Pyrite.** Rowe.

The Davis mine in Rowe has furnished the largest amount of pyrite of any locality in the State, and is perhaps the only profitable mine in the State. The mineral is abundant everywhere in the Hawley schists. An especially fine deposit occurs south of Forge Hill, in Hawley. The deposits are of greater geological than mineralogical interest.

PYROCHLORE.

See Microlite, which was claimed to be pyrochlore.

PYROLUSITE

1824. **Oxide of manganese.** Plainfield.

"Yielding vital air in abundance."

Dr. J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 252.

1824. **Black oxide of manganese.** Cummington, near Plainfield.

Cummington; compact and earthy. Also two localities of the compact variety of this ore west of Plainfield; in great abundance and of excellent quality.

Same; ibid., Vol. VIII, p. 233.

1824. **Black oxide of manganese.** Plainfield.

"Dr. Porter, of Plainfield, sent me what he calls iron ore. I have lately ascertained that it is manganese; Cummington or Plainfield."

E. Emmons: Loc. Min.; ibid., Vol. VII, p. 254.

1824. **Oxide of manganese.** Cummington.

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 57.

1827. **Manganese.** Conway.

In quartz vein 2 or 3 miles southeast of the meetinghouse.

A. Nash: Lead mines of Hampshire County; ibid., Vol. XII, p. 255.

1835. **Oxide of manganese.** Conway.

In a vein of jaspery quartz 6 to 8 feet thick; dip, 90°; strike, north 20° east; in southeast of Conway with hematite.

Same in numerous bowlders in Amherst 1 mile northeast of the college.

E. Hitchcock: Geol. Mass., p. 344.

1841. **Oxide of manganese.** Plainfield.

One mile west of Center and near southwest corner. Associated with rhodonite; mined for iron. Conway, southeast part; distinct vein in quartz, several feet wide.

E. Hitchcock: Geol. Mass., p. 205.

1841. **Pyrolusite.** Plainfield.

Several beds occur near one another at two principal places represented on the map; smaller and larger beds occur within a few feet of each other. The beds are rarely more than 3 or 4 feet thick. Apparently common pyrolusite. On breaking open the mass they are found to be of a beautiful rose red—the bisilicate of manganese of Dr. Thomson. Many blocks in wall northeast of the church in Cummington, in talcose slate.

E. Hitchcock: Geol. Mass., p. 612.

(This refers to the black decomposition products of the rhodonite.)

1878. **Pyrolusite.** Amherst. Bowlders.

Very fine specimens found by J. M. Clarke in yellow jasper, doubtless from Conway.

1879. **Pyrolusite.**

Films of pyrolusite in cleavage cracks of spodumene derived from decomposition of garnet.

A. A. Julien: Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 319.

1881. **Pyrolusite.**

Large bowlder; cavernous quartz with pyrolusite found by H. B. Patton, class of 1881, Amherst College, on east end of Holyoke range.

PYROMORPHITE.

1835. **Phosphate of lead.** Southampton.

Spherical light-green masses.

E. Hitchcock: Geol. Mass., p. 508.

1841. **Phosphate of lead.** Southampton.

Spherical light-green masses.

Ibid., p. 705.

1879. **Pyromorphite.** Leverett, south mine.

Pseudomorphs of pyromorphite in small hexagonal prisms ∞ P, 0 P. Thin films of silica containing a pulverulent mixture of limonite and a carbonate.

1885. **Pyromorphite.** Loudville.

The finest specimen I have seen is in the Kunz collection, purchased by Amherst College. It is a large mass of quartz, covered with crystals which rival those from Phœnixville in beauty. The quartz agrees exactly with the Loudville gangue.

1887. **Pyromorphite.** Loudville.

In large, thick coatings and drusy surfaces; also in a fine, brown coating on quartz, and covered by wulfenite. Occurs coating quartz in broad faces; small botryoidal, fine and rare.

In Clark collection of Smith College.

PYROPHYLLITE.

1876. **Pyrophyllite.** Leverett lead mine, North Leverett.

Pale-green, compact layer 1 to 3 mm. thick on dark-gray veinstone, which consists of blue quartz and some clearly cleavable glassy feldspar, with much barite in the mass; gives blue color with cobalt, swells and whitens and fuses with difficulty. H. = 3. Greasy feel, brittle, fibrous in places.

PYROPE.

See Garnet (1823).

PYROPHYSALITE.

See Topaz.

PYROXENE.

1824. **Augite.** Chester and Middlefield.

Abundant in amorphous masses; sahlite and coccolite.

E. Emmons: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 255.

1824. **Augite.** Chester.

Greenish-gray, brown, yellowish, tending to crystalline forms; also beautiful white augite finely granular or compact; foliated with considerable luster.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 48.

1825. **Pargasite.** Chester.

Short, green crystals with idocrase and epidote.

E. Emmons: Min. Not.; ibid., Vol. X, p. 11.

1825. **Augite.** Chester.

Abundant in amorphous masses. Sahlite and coccolite in beds in mica-slate well characterized. Found also in Middlefield in above varieties.

Robinson's Cat., pp. 42, 59.

(I have not been able to verify the above citations. The augitic sienite mentioned below is a pyroxene hornblende contact rock upon the granite, and the pyroxene is in broad grass-green blades.)

1835. **Augitic sienite.** North part of Belchertown.

Augite and feldspar, bowlders, in Amherst (Nos. 1362, 1363 in State collection).

E. Hitchcock: Geol. Mass., p. 455.

1835. **Augite.** Pelham.

With feldspar, actinolite, and sphene.

Ibid., p. 398.

1835. **Augite.** Williamsburg.

Augite rock. Granular greenish-yellowish, mixed with quartz interstratified with mica-schist and hornblende-schist, 2 miles west of the meetinghouse. Nos. 226 and 227 in the State collection. Also at Chester (Emmons).

Ibid., p. 330.

Wanting in the State Collection.

1841. **Augitic sienite.**

"The presence of hornblende in this rock and the absence of mica have led me to call it augitic sienite rather than augitic granite, although in position it is associated with granite. There are two varieties: First, black hornblende, greenish augite, and yellowish feldspar; all the ingredients, except the feldspar, exhibiting a very distinct and lively crystalline structure; this variety occurs in the north part of Belchertown. Second, augite and feldspar in bowlders in Amherst, the former being so arranged in the latter as to present the appearance of letters."

E. Hitchcock: Geol. Mass., p. 669.

1876. **Augite.** Belchertown.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College.

1881. **Pyroxene.** Pelham.

Three fine pieces of a light-colored well-crystallized pyroxene in calcite from the asbestos mine, well terminated and complex, were destroyed with the Shepard collection.

Rarely in large, stout, pale-green prisms in Pelham gneiss.

1887. **Augite.**

Occurs as a characteristic constituent of the Triassic diabase, usually microscopic, but at Titan's Pier in black curved plates several millimeters across.

1887. **Diallage.** Hatfield, Belchertown.

Occurs as a characteristic element of the Hatfield and Belchertown tonalite; in the former almost always, in the latter largely, changed to hornblende, so that it is possible that it is the source of all the hornblende; most abundant in large crystalline grains near S. and A. Craft's, Belchertown.

PYRRHOTITE.

1841. **Hepatic sulphuret of iron.** Middlefield.

In bitter spar, in serpentine. In talcose slate.

E. Hitchcock: Geol. Mass., p. 613.

1886. **Pyrrhotite.** Charlemont.

The pyrite occurring in a vein in gneiss is described as made up of pyrrhotite and true pyrite.

A. A. Julien: The decomposition of pyrite; Ann. N. Y. Acad. Sci., Vol. III, p. 398.

1891. **Pyrrhotite.** Chester.

In large, nodular masses at the emery mine. In colorless diaspore with rutile and corundophyllite.

QUARTZ.

1810. **Quartz.** Southampton lead mine.

Numerous crystals, usually very regular, sometimes large, and often so beautiful and brilliant that the cavities look as if studded with gems. Many are sufficiently perfect to deserve a place in the choicest cabinets.

B. Silliman: Bruce's Min. Mag., Vol. I, p. 64.

1818. **Quartz.**

Rock crystal, Conway, on feldspar (description); irised quartz, Leyden; granular quartz, Deerfield; radiated quartz, Whately and Shelburne; blue quartz and greasy quartz, rolled masses on banks of Deerfield River; pseudomorphous quartz, lamellar quartz, tubular or pectinated quartz, in greenstone, Deerfield; geodes and prase, North Sunderland (poor); amethyst, in greenstone, Deerfield; chalcedony, carnelian, cacholong, sardonyx and agate, in greenstone, Deerfield (described); jasper, Deerfield River and Leyden (arrows). Petrosilex (poor), same. Rose quartz, bowlder, Deerfield.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, pp. 112, 113.

1823. **Basanite.** Deerfield.

In alluvial soil on the banks of the Deerfield River, perhaps brought by aborigines.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 220.

1823. **Quartz.**

Blue quartz, Cummington. Rose, beautiful and abundant, east part of Chesterfield. Irised, abundant, Chesterfield. Red, yellow, orange, from film of metallic oxyd, greasy, Plainfield. Arenaceous, Plainfield and Cummington; abundant, burnt and crushed for sand. Stalactitic, at falls of brook in Middlefield. The crystals, which are small and have a light tinge of red, are formed on serpentine, evidently in a manner similar to that of stalactites. The specimens are of singular beauty (Emmons).

J. Porter: Loc. Min.; ibid., p. 247.

1823. **Quartz.**

Fetid, Cummington; chalcedony, Middlefield.

Milky or reddish-white with blood-red spots; cavities lined with minute and beautiful crystals, sometimes blood red, generally white or bluish (Emmons). Hornstone, Middlefield (Emmons). Agate, Chester (Emmons).

J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VI, p. 248.

1823. **Quartz.**

Limpid, Plainfield (J. Porter). In lead mines in veins in Southampton and Leverett, and in copper veins in Greenfield, here doubly terminated. In sienite in Northampton. Greenstone, Deerfield, in veins and geodes 1 to 10 inches wide. In mica slate in Conway; crystals one-tenth to 2 inches wide, in vast quantities. In Conway fragments as transparent as quartz from Madagascar. Smoky, Plainfield. Yellow, Southampton lead mine. Honey-yellow, resembling Siberian topaz, rarely at Leverett. Irised, Plainfield (J. Porter). Leyden, in mica slate. Milky, Cummington and Plainfield (J. Porter), poor. Radiated, Southampton, Whately, Leverett (in lead), Conway. Lamellar, greenstone, Deerfield; usually parallel; thin, brittle, sometimes intersecting. Conway, large, loose masses in mica-slate above 1 foot in diameter; plates often drusy, grades with common quartz. Pseudomorphous, cubes, Southampton lead mine. Deerfield in greenstone; also, at Deerfield, cavities with radiated arrangement, flattened, four-sided prisms one-half to 4 inches long (zeolite?).

Amethyst, Mount Tom (Silliman), Deerfield; geodes, light purple, one-tenth to 1 inch.

Chalcedony, Hadley, Sunderland, Deerfield, Gill, and in almost every greenstone hillock and ridge from New Haven to Gill (description).

Chacolong, carnelian, sardonyx, agate, Deerfield; in greenstone with chalcedony.

1823. **Quartz**—Continued.

Since the publication of previous accounts Dr. Dennis Cooley has discovered a new locality in the Deerfield greenstone, from which he has obtained specimens so much superior to these heretofore found that they deserve particular notice. Six specimens are described. No. 1 is without chalcedony; another, with amethyst, weighs 23 pounds. Others are described as fortification and ribboned agate, and spoken of as of the first quality.

Hornstone, Southampton lead mine; Conway. In greenstone in Deerfield and Sunderland; nodules 4 to 5 inches in gray-green, black, reddish, and dark-blue; fracture little conchoidal and glistening or dull and splintery, nearly opaque; some specimens resemble siliceous slate, others prase. Professors Silliman and Dewey, the latter of whom has examined it chemically, agree in calling it hornstone.

Jasper, Cummington, banks of Westfield River (J. Porter); banks of Deerfield River in Deerfield. Conway, Leyden, rolled, red, black, and yellow.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, pp. 214–219.

1824. **Plasma**. Pelham.

The most interesting mineral from Pelham is one which is undoubtedly a subspecies of quartz. It strongly resembles chalcedony; it preserves but little luster; its fracture is nearly even, somewhat splintery and flat-conchoidal; it breaks readily under the blow of the hammer into large, indeterminate, sharp-edged fragments, sometimes exhibiting concretions; its color is leek-green, uniformly diffused excepting occasionally small whitish dots which are distributed through the mass at nearly equal distances; it is translucent. Before the blowpipe it loses its color and becomes white. Should it belong to the subspecies chalcedony it is the variety called plasma, which has not been found hitherto in the United States. It was discovered in digging a cellar in a rounded mass upward of 2 feet in diameter.

C. U. Shepard: Min. Loc.; Am. Jour. Sci., 1st series, Vol. VIII, p. 235.

1824. **Laminated quartz**. Cummington and Plainfield.

Both milky and smoky. Jasper; blue in brook in Worthington.

J. Porter: Loc. Min.; ibid., p. 233.

1824. **Quartz**. Middlefield.

Minute pyramids in cavities in serpentine (Emmons). Smoky, banks of streams. Rose, Chester, in granite. Irised, rolled masses, beautiful, Middlefield (Emmons). Greasy, Plainfield (Porter). Tabular, Middlefield. Blue, Cummington (Porter); grayish blue, differs little from the smoky.

Laminated; new variety, Chester (Emmons); distinctly laminated, folia separate by a blow like those of calcareous spar; partially translucent; faces not smooth, and marked by oblique striæ.

Amethyst, in trap, West Springfield (Emmons). Ferruginous, fetid, chalcedony, in Middlefield in serpentine.

Hornstone, dark-blue in Middlefield in serpentine (Emmons).

Agate, Middlefield and Chester; ground-yellow jasper with bands of bluish white; one weighed 200 pounds; it seems one vast agate made up of a multitude of smaller ones.

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 37.

1824. **Quartz.**

Yellow crystals, Worthington. Fetid, Chesterfield. Chalcedony, Cummington. Jasper, red, banks of the Westfield River in Cummington.

J. Porter: Loc. Min.; ibid., Vol. VII, p. 253.

1824. **Agate.** Near Chester.

"Weight upward of 180 pounds; yellow jasper and chalcedony—a large mass of chalcedony and jasper which is in part agatized. I have since seen not far from the village a mass almost twice as large as the one mentioned above." (Came from the serpentine.)

E. Emmons: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 256.

1825. **Quartz.**

Plainfield, blue, good color. Shelburne, radiated.

J. Porter: Loc. Min.; ibid., Vol. IX, p. 54.

1825. **Quartz** (after calcite). Williamsburg.

"This mineral has the form of hogtooth spar incrusted with very minute crystals of quartz, but on breaking it it is found to be hollow with larger crystals at its base, or in some few instances it is wholly filled up with semicrystalline quartz."

Hampshire Gazette, July 14, 1824. Quoted by J. Porter in Min. Not.; ibid., Vol. IX, p. 54.

1825. **Quartz.** Chesterfield.

Crystallized in the form of the primary rhombohedron in feldspar; dull, one-fourth inch long, lateral edges usually truncated.

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 608.

1825. **Quartz.**

Amethyst, Mount Tom; beautiful crystals. West Springfield (see Am. Jour. Sci., 1st series, Vol. VIII, p. 38.) Flint, in bituminous shale of coal formation. Blue jasper, Worthington, margin of brook (J. Porter). Chalcedony, Amherst; in rolled masses, of fine blue color in a brook.

Robinson's Cat., pp. 35, 65, 74, 78.

The latter was in bowlders from Conway.

1825. **Amethyst.** Belchertown.

In a rounded mass about 18 inches in diameter, composed of imperfect prismatic crystals of extraordinary size which shoot out from a quartzy gangue containing galena, blende, and copper pyrites. Many of these crystals terminate in regular pyramids at the surface, but just previous to their termination the amethyst passes through them in a vein from 1 to 2 inches in width, and below the vein are zigzag striæ of milky quartz, which render many of the crystals very beautiful.

C. U. Shepard: Loc. Min.; Am. Jour. Sci., 1st series, Vol. IX, p. 47.

(Specimens in cabinet of Amherst College.)

1825. **Quartz.**

Announces the discovery of a new mass much larger than the one first found of the Pelham prase. (Plasma, above, 1824.) It is more uniformly colored, does not have whitish and yellowish spots distributed through it, and is of a deeper color; in a single place it passes into common quartz. "I think there is no doubt of its being the hornstein eccailleux of Brochant."

C. U. Shepard: Loc. Min.; ibid., p. 47.

1825. **Quartz** (after fluor). Westhampton.

"The quartz is formed in the vicinity of the argentite; some of these projections are rectangular; perhaps these were formed upon crystals of

1825. **Quartz** (after fluor)—Continued.

sulphuret of lead, as some lead is found in the rock. We have found but a few of the cubic projections. The dogtooth formation is found in abundance." (The cubes show the twinning of fluor.)

Letter of Mr. Morris Dwight; Am. Jour. Sci., 1st series, Vol. IX, p. 176.

1825. **Quartz** (after calcite). Loudville mine.

Hexahedral prisms with trihedral summits grouped in cavities in quartz, one-half inch in diameter; brownish-yellow, drusy.

C. U. Shepard: Min. Loc.; ibid., Vol. IX, p. 249.

1825. **Amethyst** (in greenstone). West Springfield.

Emerson Davis: Min. Not.; ibid., p. 252.

1826. **Tabular quartz.** Palmer.

Of a wine-yellow color, found in abundance in Palmer at the site preparing for the new factory at Three Rivers. The crystals may be obtained in large groups, well defined, and embedded in coarse granite.

Anon: Chem. and Min. Jour., Vol. I, p. 78.

1826. **Quartz.**

Stalactitical, Middlefield, Cummington, Worthington. Radiated quartz, covered with crystals, Goshen and Williamsburg. Blue jasper, in branch of Westfield River, Chester.

J. Porter: Min. Not.; Am. Jour. Sci., 1st series, Vol. X, p. 18.

1835. **Quartz.**

Amethyst. One mile east of Deerfield, 3 miles south and east of Bloody Brook. Mount Holyoke and West Springfield—here smoky. Tabular, 1 mile east of Deerfield. Chalcedony, gray and yellow, east of Deerfield, and Greenfield on west side; rare on east side of the mountain. Agates usually small; those found by Dr. Cooley, 2 miles northeast from Bloody Brook meetinghouse (South Deerfield), 9 by 6 inches; weight, 23 pounds; outside green one-half inch, then flesh colored, then amethystine (No. 1191). Fortification agate. Chalcedony is also found in the Middlefield serpentine, and it sometimes passes into hornstone. Large rolled masses of these minerals, often agatized, have been found in Middlefield and Chester, which probably proceeded from some serpentine locality. Also in the same, serpentine drusy quartz of extreme beauty.

Pelham. In bowlders scattered over several acres; fine crystals, limpid, commonly light-brown to fine topaz-yellow, rarely amethystine, 2 inches in diameter; with this, fine chalcedony milk-white to delicate olive.

E. Hitchcock: Geol. Mass., pp. 371, 399, 435.

1841. **Quartz.**

Nearly all the preceding localities cited; also Whately; delicate crystals in sienite, druses with blade-like cavities from removal of crystals (barite). Pelham, south part; crystals in large quantity, some of which will answer for the lapidary; hornstone (Shay's flint), mass presented by O. M. Clapp to E. Hitchcock. Goshen, crystals of smoky quartz. Blandford, Chester, Chesterfield, Williamsburg, rose quartz. Southampton, Westhampton, pseudomorphs after calcite and fluor. Mount Holyoke, amethyst; also Amherst, in rolled masses. Conway, southeast part, vein 6 to 8 feet of brown and yellow jasper and black, brown, white, red, and yellow chalcedony, rarely banded agate; whole often brecciated; with hematite and pyrolusite; same abundant in bowlders in Amherst.

E. Hitchcock: Geol. Mass., pp. 186, 604, 700.

1844. **Quartz.** (*Hyalus rhombohedrus*). Pelham and Chesterfield.

Yellow jasper. Chester.

J. D. Dana: Sys. Min., p. 412.

1859. **Crystallized quartz.** Norwich. Angell's mine.

E. Hitchcock: Cat. State Geol. Cab.; Rep. Agri. Mass., Vol. VI, App. LXIX.

An examination of these specimens which are contained in the collection deposited at Amherst College shows that they are beautiful pseudomorphs after calcite—$\frac{1}{2}$ R, and that the broad, flat plates from 1 to 3 inches square and of drusy surface are pseudomorphs after barite.

1876. **Quartzite.**

Name proposed in place of quartz.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst, p. 6.

1879. **Quartz.** Chesterfield Hollow.

Pseudomorph after spodumene, very rare, 6 to 9 inches long, sharply defined, not terminated.

A. A. Julien: Spodumene and its alterations; Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 350.

1882. **Hornstone.**

In abundant half-inch veins in a layer of decomposed gneiss with laumonite, north end of Monson quarry; leek-green.

1882. **Quartz.** Deerfield.

Only in a single specimen from the Cheapside veins did quartz appear associated with the zeolitic minerals. Here a few minute, elongated prisms appear in and on prehnite. Toward the upper surface of the dike occur veins 4 to 5 cm. wide—coarse, comby quartz, whose terminations interlace irregularly at the center. Between the wall on one side and the regular cockscomb quartz, a layer 10 mm. thick of broken-up quartz crystals, recemented by quartz, showing that the vein had once partly filled itself and then by the rubbing together of the walls the work was interrupted. In other parts of the vein the quartz is much gashed by broad, thin cavities, which are often as many as twelve, one above the other, and parallel to the walls as well as scattered in various directions. They seem to have been produced by the repeated formation of a layer of some mineral, now wholly gone, probably selenite or barite.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 351.

1883. **Yellow jasper.**

Bowlder in North Amherst, but doubtless from the vein in Conway (see 1841, above). Filled with spherical globules of hematite just visible with lens. Analysis by Mr. Wm. Orr, jr., class of 1883, Amherst College. Heated twenty-four hours on sand bath with KHO. Sp. gr. 1.20.

Analysis.

SiO_2 (soluble)	55.59
SiO_2 (insoluble)	26.34
Fe_2O_3	15.77
Mn_2O_3	.62
	100.87

1885. **Quartz.**

In quite large crystals and fine drusy crystallizations, colorless and amethystine, rarely showing only tetrahedral faces. In many cases filled with minute (1 mm.) globules of hematite so orientated that over a broad surface all the crystals are filled on one side and looking from the opposite direction the globules are all invisible. In diabase south of Titans Piazza.

1885. **Chalcedony.** Chester.

Thick masses of amber color, fine botryoidal with stalactitic forms and incrustations of rootlets from the serpentine.

Google

1885. **Agate.** Granby.

Veins 20 to 25 mm. thick of a fine, bluish-white agate occur in the fourth volcanic core east of the road running south from the Notch.

1894. **Quartz.** Warwick.

At the epidote locality at Crystal Hill, north of Hastings Pond, fissures in the epidote garnet rock are filled with long slender quartz crystal 5 to 6 cm. long, which project freely into the cavity, are transparent, and perfectly terminated with one terminal face predominant, as in the Dauphinée crystals.

1895. **Quartz.** (Pseudomorph after galena.) Southampton lead mine.

Hollow cubes, often a half inch across, often with parallel ridges on the inside, when the quartz penetrated into the cubical cleavage planes of the galena.

QUINCITE.

See Montmorillonite (1876).

RHODOCHROSITE.

1825. **Carbonate of manganese.** Cummington.

Flesh-color and rose-red, outside gray to black; recent fracture soon changes to dark color if exposed to moisture.

Effervesces sharply with acid in powder; NO_5 dissolves it entirely; before blowpipe browns; infusible. In large amorphous mass in many places in Cummington; has been called red oxide of manganese; by others siliceous oxide of manganese and gray oxide of manganese. All the specimens I have examined effervesce in acid.

E. Emmons: Am. Jour. Sci., 1st series, Vol. IX, p. 249.

1852. **Diallogite.**

A pulverulent pink variety coating triplite in granite; occurs at Goshen and Norwich.

C. U. Shepard: Min., 3d ed., p. 96.

1891. **Rhodocrosite.** Hawley.

Impregnating the fine granular quartz adjacent to the magnetite-hematite veins at the old mine on the Howes place (Forge Hill), and farther south on the vein in the Cressy pasture. It forms a flesh-colored sandstone which blackens rapidly.

1892. **Rhodocrosite.** Hawley.

The following analysis by Mr. L. G. Eakins, of the United States Geological Survey, represents the composition of the flesh-colored arenaceous rock from the mine of Mr. C. V. Cressy in the pasture just south of the road over Forge Hill.

Part soluble in HCl:	
FeO	2.40
MnO	28.44
NiO	.02
CoO	Trace.
CaO	10.98
MgO	1.29
CO_2	28.71
	71.84
Insoluble in HCl, nearly all quartz	26.68
	98.52

RHODONITE.

1824. **Siliceous oxide of manganese.**

Specimens obtained in Chesterfield, but exact locality not learned.

W. Meade: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 54.

1824. **Siliceous oxide of manganese.**

Chesterfield, near the locality of sappare (kyanite), associated with green feldspar in granite.

C. U. Shepard: Loc. Min.; ibid., p. 251.

(I have not been able to rediscover this locality, and doubt the occurrence of rhodonite in granite in the Conway schist.)

1825. **Oxide of manganese.** Cummington.

"In immense quantity one-half mile west of Congregational church on land of Mr. Packard. It would be an easy matter to collect at this locality 50 tons of the mineral. * * * I could not find the ore in place, though from the appearance of some specimens I have little doubt that they form a bed in mica-slate. [Suggests that the black coating is derived by oxidation from the pink.] Mr. Bryant, who lives near the spot, pointed out to me a specimen which had been broken a year or two since and which by simple exposure to the weather since that time had already become coated by a thin pellicle of the black oxide."

E. Hitchcock: Loc. Min.; Am. Jour. Sci., 1st series, Vol. IX, p. 22.

1825. **Siliceous oxide of manganese.** Cummington and Plainfield.

In considerable abundance.

J. Porter: Ibid., p. 55.

1827. **Siliceous carbonate of manganese.** Cummington.

At junction of mica-slate and talcose slate, 2 miles north of the meetinghouse in Cummington. Exposed in place, several feet wide, 15 to 20 rods long; black and gray oxide in abundance, and along with them there is a small vein of the siliceous carbonate also embedded in the black oxide; it was supposed to contain iron, and a forge was erected. The masses are found on the ground in the immediate vicinity of the vein and scattered clear across the town, and also north in Plainfield.

A. Nash: Lead mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 249.

(This must be the main opening at T. Williams's, which is 3¼ miles northwest of Cummington, as a point 2 miles north of Cummington would not be near the junction of the schists.)

1835. **Manganese spar.** Cummington.

C. U. Shepard: Min., Part II, Vol. II, p. 24.

1841. **Bisilicate of manganese.** Plainfield, 1 mile west of center.

"In beds of interstratified layers in talcose slate, rarely more than 2 to 3 feet thick; several of them occur near one another at two principal places represented on the map. Their surface is black or dark gray, apparently the common pyrolusite. In the interior beautiful rose red. Recently analyzed by Dr. Thompson and found to be bisilicate of manganese. In stone walls a little northeast of the meetinghouse in Cummington in numerous large blocks, probably transported thither from the beds above described. In talcose slate."

E. Hitchcock: Geol. Mass., p. 613.

1849. **Mangan amphibol.** (Hermann.) Cummington.

Hermann: Jour. Prac. Chem., Vol. XLVII, p. 7.

(The above name was based on an error and gave rise to the two following names.)

1853. **Hermannit.** (Kenngott.) Cummington.

A. Kenngott: Min., p. 71.

1860. **Cummingtonite.** (Rammelsberg.) Cummington.

C. Rammelsberg: Min. Chem., p. 473.

1868. **Rhodonite.** Cummington.

J. D. Dana: Min., p. 235.

1875. **Cummingtonite.**

"Soll eine Manganhornblende sein."

C. Rammelsberg: Min. Chem., 2d ed., Vol. II, p. 400.

1877. **Hermannit.** Cummington.

F. Zirkel (Nauman): Min., p. 606.

(The ancient error is still carefully preserved and Hermann's mangan amphibol cited.)

1885. **Rhodonite.** Warwick. Near Winchester and Hinsdale, N. H. Cummington, in bowlders.

G. F. Kunz: Precious stones of the United States; Rep. Min. Res. U. S. for 1883–84, p. 766.

1888. **Rhodonite.** Cummington.

"The rhodonite so well known as occurring as bowlders at Cunningham [sic], Mass., has recently been traced to the ledge, and we may now hope to see the rock used extensively for decorative and ornamental purposes, as at this locality it is one of the richest pink and flesh-colored minerals known."

G. F. Kunz: Precious stones, in Min. Res. of the U. S. for 1887, p. 562.

1889. **Hermannit.** Cummington.

Groth: Tabell. Uebersicht d. Min., p. 134.

A persistent error (see 1849, above).

1889. **Rhodonite.** Cummington.

Polished specimens of thin-cut stones and a vase were shown in Tiffany's exhibition of gems at the Exposition in Paris.

G. F. Kunz: Private communication.

1890. **Rhodonite.** Cummington.

Announces the discovery of the ledge. "Fine masses weighing several hundred pounds have been blasted out, and an effort will be made during the coming year to introduce this as an ornamental stone."

G. F. Kunz: Gems and precious stones of the U. S.; Min. Res. of the U. S. for 1888, p. 582.

1891. **Rhodonite.** Cummimgton, Warwick.

"On Osgood's farm,[1] Massachusetts, and in the neighboring towns; in Warwick, Mass. The rhodonite of Cummington of the richest flesh and light-red color was found only in bowlders previous to 1887, when it was traced to the ledge by W. W. Chapman. Blocks were taken out weighing some hundreds of pounds each, of a rich pink and red color, and with large surfaces entirely free from streaks of black oxide, and in other places beautifully mottled; they were equal in quality and beauty to the Russian rho-

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[1] Cummington should probably be supplied here.

1891. **Rhodonite**—Continued.

donite, which is made into vases and also table tops and mantels. This material has been used very effectively in combination with unpolished or stone-finished silver as handles for very fine ornaments, the rose color streaked with black affording a pleasing contrast. Its hardness is only 6.5, but it is nearly as tough as jade.

G. F. Kunz: Gems and precious stones of the U. S., pp. 151, 152

1891. **Rhodonite.** Cummington, Plainfield, Hawley.

I have given in the monograph on the geology of the region a full discussion of the long series of manganesian deposits situated on the fissure, extending from the old manganese mine near the south line of Plainfield, at T. Williams's, where it is exposed in great width, to the well-known mine of specular iron on Forge Hill, in Hawley, and have described the occurrence of rhodonite at many new points along this line. All the masses of the mineral found in Cummington are glacial bowlders from Plainfield, and the reputed discovery of the ledge in Cummington has no basis in fact. A few large bowlders were uncovered in a trench at the old locality and were supposed to be the ledge.

1892. **Rhodonite.**

"Occurs in Cummington and some of the neighboring towns in bowlders; also in Warwick."

E. S. Dana: Sys. Min., p. 380.

RHŒTIZITE.

See Cyanite, 1835.

RUTILE.

1812. **Oxide of titanium.** Worthington.

Dark-red crystal longitudinally striated; the surface splendent and somewhat iridescent; embedded in white, semitransparent quartz, part granular and part compact, which occurs in beds of hornblende slate. From Dr. John F. Waterhouse.

A. Bruce: Bruce's Min. Jour., Vol. I, p. 237.

1818. **Red oxide of titanium.** Leyden, Shelburne.

At Leyden, on quartz and tremolite; brownish-red; sp. gr. 4.232; geniculated, sometimes several geniculations on a single specimen; in one, six.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 116.

1823. **Red oxide of titanium.** (Bruce.) Worthington.

"Leyden; in four- or eight-sided prisms, often handsomely geniculated, generally striated, in limpid quartz, tremolite, and hornblende. Some of the specimens have several geniculations and are as large as the thumb. Hundreds of good specimens have been collected at this locality.

"At Colerain and Shelburne I found it penetrating a vein of quartz in mica slate in place. In Conway a few small crystals have been observed exhibiting the primitive form and presenting the kind of twin crystal described in Rees's Cyclopedia, art. Rutile. May be found anywhere on a strip several miles wide between Conway and Brattleboro, Vt."

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 236.

1824. **Red oxide of titanium.** Cummington.

Dr. J. Porter: Loc. Min.; ibid., Vol. VII, p. 58.

1824. **Ferruginous oxide of titanium.** Chester (Emmons).

It has some resemblance to schorl, but is infusible; occurs in smallish, long, imperfect, nearly black prisms in granite; rare.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 58.

1824. **Red oxide of titanium.** Middlefield (Emmons).

Flat plates in quartz.

Ibid., p. 59.

1824. **Ferruginous oxide of titanium.** Chester.

"I have discovered one large specimen of ferruginous oxide of titanium in granite, or, I ought to say, a mass of granite, containing 20 or 30 imperfect crystals."

E. Emmons: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 255.

1825. **Red oxide of titanium.** Norwich (now Huntington).

Near beryl locality in north of town. In large quartz veins in mica-slate.

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 608.

1825. **Red oxide of titanium.**

Cummington, in mica-schist. Plainfield, well crystallized.

J. Porter: Loc. Min.; ibid., Vol. IX, p. 55.

1825. **Red oxide of titanium.** Cummington, Conway, Goshen.

Stone walls; quartz in mica-slate (C. U. Shepard). Leyden, Worthington (Cleaveland), Middlefield, Shelburne.

1825. **Ferruginous oxide of titanium.**

Chester, with augite and actinolite; likewise in sienite. Goshen, in stone wall in mica-schist (Shepard) and quartz.

Robinson's Cat., pp. 42, 51.

1827. **Red oxide of titanium.** Williamsburg.

In quartz in mica-slate; crystals as large as a man's thumb and handsomely geniculated.

Goshen and Chesterfield; Conway and Whately; wherever there are granite veins, or where quartz lies contiguous to mica-slate, and in nests of quartz in mica-slate.

A. Nash: Lead mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 259.

1831. **Red oxide of titanium.** Cummington.

Fine crystal near soapstone quarry.

J. Porter: Loc. Min.; ibid., Vol. XX, p. 170.

1835. **Red oxide of titanium.**

Leyden, with zoisite. Shelburne, Colerain, Conway, Williamsburg, Chesterfield, Middlefield, Whately, in sienite. Windsor, in chlorite slate near the most eastern soapstone quarry, in feldspar, or rather in graphic granite, which occupies seams in chlorite slate.

E. Hitchcock: Geol. Mass., pp. 349, 462.

(The Whately mineral is allanite.)

1838. **Titanium.** Norwich.

Farm of Mr. Quartus Angell, in vein 3 feet wide, with galena and blende.

E. Hitchcock: Econ. Geol., p. 127.

1841. **Red oxide of titanium** or **rutile.**

In mica slate; four to eight sided prisms, generally striated, sometimes geniculated. With zoisite in Leyden, abundant, sometimes penetrating quartz, sometimes is connected with hornblende. Shelburne, in distinct crystals alone. Colerain, Conway; in latter place one or two geniculated prisms more than an inch thick, also in small, right square prisms; Williamsburg, Chesterfield, Middlefield.

E. Hitchcock: Geol. Mass., p. 607.

1844. **Rutile.** (*Rutilus quadratus.*) Shelburne, Leyden. Conway.

J. D. Dana: Sys. Min., p. 420.

1876. **Rutilite.** Pelham, Conway, Shelburne, Chester.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 7.

1883. **Rutile.** Westhampton, Chester.

In geniculate crystals an inch long; north part of Westhampton, at residence of Mr. James Howard. In epidotic hornblende schist in Chester.

E. E. Bancroft, class of 1883, Amherst College.

1884. **Rutile.** Pelham asbestos mine.

Occurs in beautiful, geniculate twins in cavities in tourmaline with apatite prisms and in disseminated red-brown grains and microscopic crystals in massive anorthite, 1¼ cm. from contact with massive tourmaline.

1885. **Rutile.** Rowe.

In pyrite at J. M. Davis & Co.'s mine; steel-gray; good crystals.

A. G. Dana: Gahnite of Rowe; Am. Jour. Sci., 3d series, Vol. XXIX, p. 456.

1885. **Rutile.** Chester emery mine.

The rutile follows corundophyllite, generally in fine needles, hair brown, shining, striated; at times bent and twisted; generally grouped into sagenite-like bundles of striated needles; rarely twinned, but at times showing a most beautiful lace-work of needles crossing at 60° and 120°, which is set free by the solution of the calcite; at times shorter crystals occur, 10 by 15 mm. across.

There are fine brown-red sagenite needles in a reticulate network at 60° and 120°, together with striated geniculate twins 10 by 15 mm. across, in the cabinet of the late Mr. Ames, of Chicopee.

SALT.

1880. **Chiastolite.** Near Springfield, Mass.

My attention was called to these forms as problematical, possibly chiastolites, from near Springfield, by Professor Dana, with reference to Mr. B. Horsford, of Springfield, and Mr. J. S. Diller.

1888. **Salt.** West Springfield. (See Pl. I, B, C.)

In black Triassic shale in bottom of Westfield River, near bridge below the town. Skeleton cubes pseudomorph in calcite, appearing on surface of the black shale in white crosses, squares, and triangles one-half to three-fourths of an inch across, which have been for years called chiastolite. They were determined by me from a study of thin sections, and were found to effervesce with acid.

Specimens received from Mr. J. S. Diller, and sections cut.

1889. **Cavities from salt crystals in Triassic sandstone.** Wilbraham.

Flattened, cubical hollows, with ends 1 by 4 mm. to 4 by 9 mm., in rusty sandstone from the base of the Trias, east of the academy and near contact on mica-schist.

1890. **Salt.** Holyoke.

In drift near west end of Connecticut River Railroad Bridge. Found by Rev. J. Provost, of Springfield, Mass. Specimen now in the Smith College collections. (See A, Pl. I, from photograph.)

Forms larger and more delicate than at Westfield; largest cube 32 mm. The slender white lines, often with a black central suture, start from a point or from the corners of a small white square with black center. They are often symmetrically bordered by a feathery fringe of white, broadest at base and lessening outwardly, like frost flowers or the microlites in Arran pitchstone. That they are cross sections of skeleton cubes is made clear by sections of the same crystal at right angles to each other on the side and end of the block. The rock is a black shale, and the joint plane at one end is incrusted by coarse calcite with streaks of bitumen and rust.

1890. **Salt.** Holyoke.

The impressions of minute salt crystals also occur on the very thin, laminated, and fine-grained sandstone cut through in carrying the water main east from Ashleys Pond, in Holyoke, in lines crossing each other at 90°; lines diverging at 60°, and small impressed squares with lines diverging from the four corners.

1892. **Spinel.** Near Springfield, Mass.

Octahedral crystals tesselated like chiastolite embedded in slate.
E. S. Dana: Sys. Min., p. 222.

1894. **Octahedrite.** West Springfield.

I have in time past had much correspondence with Mr. Horsford concerning these forms. He considered them a new mineral, an eightfold dissectible crystal, each component having the shape of the octant of an octahedron, and he proposed the name octahedrite for the form. He expressed the intention to publish his results as part of a larger work on geology, of which the manuscript was prepared and partly printed, but never published.

The following quaint letter explains more fully than I have done Mr. Horsford's opinion concerning his mineral, and will be of interest to many who remember his peculiar, Indian-like appearance and his crisp, impulsive speech.

The first lines and the allusion to Professor Shepard are interesting reminiscences of early studies of chiastolite, and refer to the dissected figure, which has for many years appeared in the different editions of Dana, and which has given rise to German citations of chiastolite from Springfield, Mass. As the author died two years ago, and his representatives do not object, and as his promised book will probably not be printed, I reproduce the letter, following religiously the injunction of the author. The letter was accompanied by a small octahedron carefully cut in pine wood, and with blackened corners to show the three black plates mentioned below:

"NORTH THETFORD, VT. (No date. Received about 1890.)

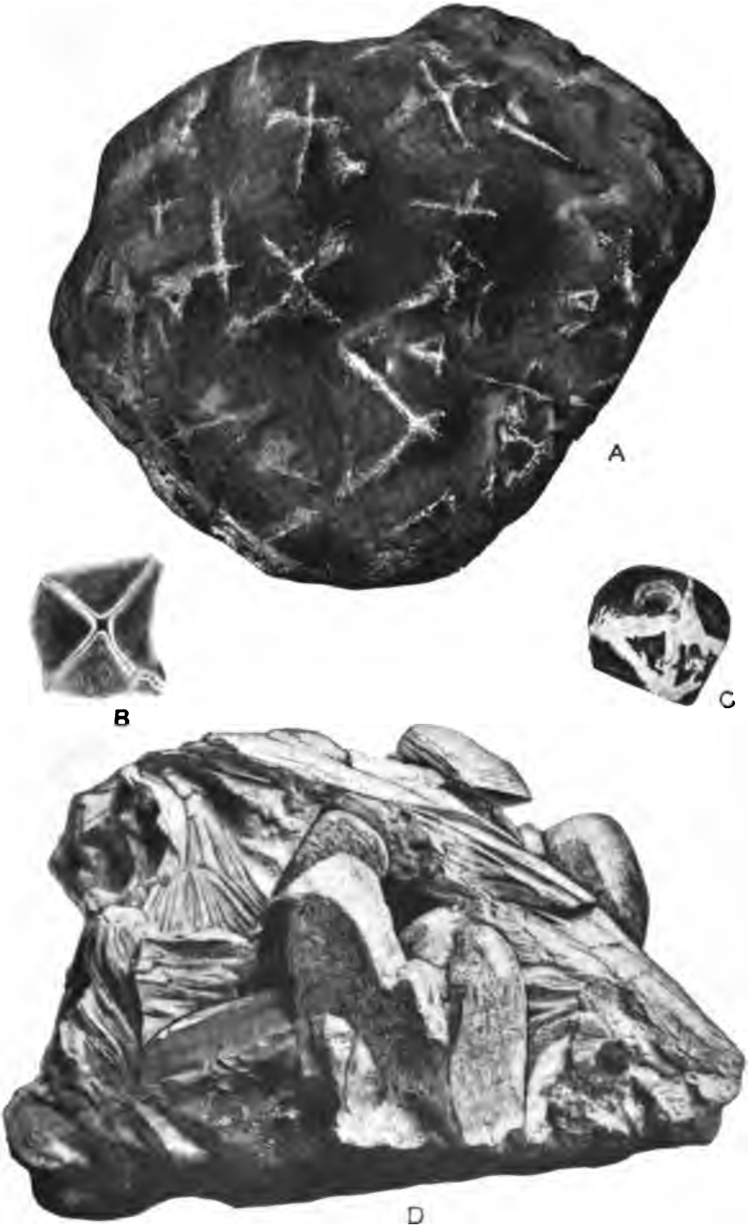
"DEAR SIR: The chiastolite, a right square or rhombic prism, is composed, as you see, of five right square pyramids (black) and four triangular pyramids (white) fearfully elongated, all of massive structure and inseparable. My octahedrite, a regular octahedron, white, is bisected through its angles by three black plates, which diagonally, at right angles, bisect each other. These plates are walls of division; consequently the octahedron is composed of eight triangular pyramids, separable and of distinct laminated structure. You may wonder that a New Englander, a Yankee

1894. **Octahedrite**—Continued.

Puritan thoroughbred, should carry a discovery like this twenty years in his pocket with no effort at heraldry or one attempt to turn it into cash. But you will acquit me of weakness in that direction when I say I had possession of all the specimens discovered and all that would be discovered until there was another upheaval—a contingency I could well risk. I am not able in a letter to say what I would, not knowing just what you desire. My researches for twenty years past are all embodied in a work in publication, and of which I send you the first chapter with the assurance I mean all I say and can sustain it. I could doubtless contribute somewhat to your report, but that could only be by extracts from my own book. I would show you where the mica schist overlies the sandstone and where basalt does the same; where, in an opening in the sandstone, there was an irruption of fetid limestone with stalactites in all the curly crinkles of malachite, but of shades from brown to black. The elder Hitchcock, in his first report on the geology of Massachusetts, described them as radiaria (petrified worms). His engrossing study of bird tracks at that time made the oversight pardonable. You will see at once the position in which I am placed. In my treatise the geology of New England is treated with a philosophic scrutiny it has not before seen, however much needed, holding as it does a more direct and unimpeachable testimony of the earth's early history than any field of equal extent on the globe.

"I acknowledge I am *savage* in treatment of the glacial theory, but assuming less I had better kept silent. But if fact and philosophy both sustain my position, as they certainly do in overwhelming multiplication, I could not say less or too much. I can show you three 100-ton bowlders of granite which have burst asunder in the past five years, one I had known half a century without seam or fracture in it. All burst in one direction, and at the same angle from perpendicular, and through the middle. Would not geologists attribute that work to Achæan time rather than the present? I have never found a specimen 100 feet from one spot (point). I have not been able to obtain a single specimen in the past five years. I have a few crystals developed showing just what the model does. I have a few halves, quarters, and eighths of the octahedron, but consider them invaluable, as they can not be duplicated. I have never sold or given a specimen to any person living. I did not discover for years that the pyramids were separable. You may think I hold this thing with grip of iron, but it is not so. Approaching my eightieth birthday, it is a fair hope that I have gathered a little wisdom or moiety of caution by the way. When I dissected the andalusite, at the solicitation of your late Professor Shepard, I sent description and illustration to the Natural History Society of Boston, but never received a word of reply.

"Two years ago, I think (this is allegory), a doctor came up to Springfield from Harvard to consider the case of a *sickly infant*, administering a dose of '*rehash of old hash*' on the sandstone. Well, either from the prescription or the method of administration, the poor thing gave a gasp or two and 'passed away.' At the close of the lecture, however, we gathered about the speaker for a friendly chat. When the question of the crystals came up, it was thrown back in my face with 'It is beyond my comprehension; I do not wish to know or hear anything in regard to it,' with other exclamations I did not wait to hear (Shaler). These things have been often repeated in my long life of research, so that what I might contribute to the geology of New England, if given at all, must be with the assurance from the Secretary of the Interior that it shall be published in my own words and under my own signature exclusively.



CRYSTALS OF SALT AND HAMPSHIRITE.

A. Pseudomorph in calcite of skeleton crystals of salt
B. Central section of above salt pseudomorph.
C. Section of corner of same crystals, showing feathery outgrowth.
D. Hampshirite; pseudomorph of serpentine after olivine.

1894. **Octahedrite**—Continued.

"The crystals are embedded in black shale just like cherries in a pudding. I have them in hundreds, which I should be happy to show you on my return to Springfield.

"Do not mistake me, I am willing to give all the assistance in my power; but as I am publishing it all in a work of my own, I must not impair or imperil that. The survey on which you are engaged must take years of time. I should like to know more about it, as I am, and shall be while I live, actively engaged in geological research.

"I shall be here probably till September.

"Yours, truly,

"B. HORSFORD,
"*North Thetford, Vt.*"

The following appears as a separate marginal note:

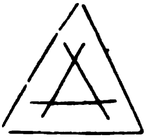


FIG. 4.—Section of salt pseudomorph.

"One side of the octahedron, the first discovered. The crossing lines of the triangle are mathematical (please demonstrate)."

1894. **Salt pseudomorphs.** West Springfield.

Through the kindness of a daughter of Mr. Horsford the finest specimens from his collection have been presented to the collection of Amherst College. They are smaller than those from Holyoke. One slab 7 inches square and finely ice-polished shows the forms in great beauty, and especially six-rayed stars from sections normal to the octahedral axes of the cube.

1894. **Calcite pseudomorphs after salt in Triassic shale.**

"A specimen of the fine black shale of Triassic age is covered with white lines arranged in triangles, crosses, and lines radiating from the corners of small squares. A feathery outgrowth at times borders these lines. The material is calcite, and the lines are tracings of the various chance cross-sections of skeleton cubes, about an inch in diameter, presumably of salt, replaced by calcite. The extreme delicacy of the forms, the feathery outgrowths, and the lack of broken specimens indicate that they were formed in place in the soft mud. They were, I think, discovered by Mr. B. Horsford, of Springfield, and were much studied by him. They have been called chiastolite, and are cited as spinel in Dana's Manual, 1892. The specimen shown was a bowlder from Holyoke. Mr. Horsford's specimens were from West Springfield."

B. K. Emerson: Bull. Geol. Soc. Am., Vol. VI, p. 473.

SAPONITE.

1882. **Saponite.** Deerfield.

Product of decomposition of natrolite. In many cases the natrolite has changed peculiarly into saponite. At first the tips of the needles become opaque and crumbling, and this extends to the whole group, and the whole sinks down into small masses from milk-white to straw color, which are spread over the surface of the prehnite like a thick layer of

1882. **Saponite**—Continued.

dried cream, with abundant shrinkage cracks. The hardness is 1 or less. It gives up only a little iron with hydrochloric acid, and is quickly decomposed by hot sulphuric acid. A portion introduced into a drop of water falls asunder much like starch—which it every way resembles—with a series of slight explosions, which occur at first in rapid succession and continue, growing fainter and farther apart, for some little time until the whole is spread in a broad circle upon the glass. This process exposes minute glassy fragments of prehnite. The flakes after their dispersion present a peculiar appearance under the microscope. The first impression is strikingly that of a slide of nearly dried blood corpuscles of uniform size, 0.005 to 0.007 mm., the single disks being variously attached to each other. Separate groups of disks often simulate closely in shape the grub of the common May beetle. The scales polarize brightly in bluish tints and are indistinguishable from kaolin. In many cases a small mass of the mineral seems to have undergone this vermiculite-like reaction in the vein itself, and a delicate bloom is spread in a circle over the prehnite or epidote surrounding a minute hollow cup of the same white or straw-colored material. In one curious case a minute hollow cube, with a side broken in, has a tuft of natrolite needles perched in and around it, these latter having minute dodecahedra of fluor strung upon them, as described below. The whole is now transformed into or coated with the saponite, and a delicate bloom of the same coats the surrounding epidote.

B. K. Emerson: Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 356.

SAPPARE.

See Cyanite.

SAPPHIRE.

1876. **Corundumite.**

Pelham: Blue (sapphire) and gray.

Chester: Blue (sapphire) and brown; the latter mixed with magnetite (emery).

C. U. Shepard: Cat. of Min. within 75 miles of Amherst, p. 6.

See Corundum.

SCHEELITE.

1864. **Tungsten.** Chesterfield.

In albite near cassiterite.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XXXVII, p. 407.

1867. **Scheelite.** Chesterfield.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst, p. 2.

1868. **Scheelite.** Chesterfield.

The above cited.

J. D. Dana: Sys. Min., p. 606.

(The specimen upon which the above determination was made was probably burned with the Shepard collection. Professor Julien does not mention the species in his exhaustive study of the Chesterfield locality.)

SCOLECITE.

1882. **Scolecite.** Ward's quarry, Pelham.

In Pelham gneiss in fissure with and on prehnite.

In radiated needles 60 mm. in length, single needles 3 mm. in width; in twins P, ∞P, ∞P∞. Swells abundantly under the blowpipe; extinction 14° from the long axis.

1887. **Scolecite.** Granby.

In the eighth volcanic core east of the Notch road in Granby. Veins of bluish agate contain very sharp casts of square prisms 2 by ½ mm. in cross-section with flattened transversely striated ends exactly resembling scolecite.

SCAPOLITE.

See Enstatite, 1835; Zoisite, 1824.

SEPIOLITE.

1876. **Sepiolite**; varieties, meerschaum and hampshirin. Middlefield.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 3.

The termination "ine" was proposed in this pamphlet as a sort of limbo in which poor species might be reserved for adjudication, and "in" for varieties. This suggestion has been nowhere adopted. For hampshirite, see page 91. It is a compact serpentine and has no similarity to sepiolite. The specimens labeled "meerschaum" in the Shepard collection were weathered portions of the Middlefield serpentine bed, which had lost their color and become light and porous from the leaching out of a portion of the mass.

The presence of true sepiolite has not been established.

SERPENTINE.

1818. **Serpentine.** Leyden.

Rolled masses.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. 1, p. 114.

1818. **Serpentine rock.** Southampton, Russell.

At 723 feet from the entrance of the Southampton adit is a stratum of serpentine rock containing very red quartz embedded in various directions. It is very compact and mostly green; here it is but 3 feet thick. It is compared with the Westfield bed; at 670 feet there is beautiful green soapstone.

Also, near line of Westfield and Russell, 4 miles west of Westfield Academy. Very great breadth; in the granitic hill east of highest ridge of granite.

A. Eaton: Southampton adit; Am. Jour. Sci., 1st series, Vol. I, p. 137.

1820. **Serpentine.** Middlefield.

Discovered by E. Emmons. Description given; associated minerals, quartz, steatite, actinolite, talc, dolomite.

C. Dewey: Ibid., Vol. II, p. 236.

1820. **Serpentine.** Westfield.

Four miles west of academy. "I discovered a very extensive bed of serpentine."

A. Eaton: Index, p. 100.

1821. **Serpentine.** Russell.

Specimens sent to Professor Silliman by Dr. William Atwater, and described by the former. Also from a mountain 15 or 20 miles from Westfield, a bluff large as East Rock (probably Middlefield).

Am. Jour. Sci., 1st series, Vol. III, p. 238.

1823. **Serpentine.**

Westfield, in granite (Eaton). Middlefield, associated with steatite (Dewey). Pelham, in a large, loose mass, penetrated by asbestos and associated with talc.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 227.

1824. **Asbestus (Amianthus).**

In very strong and flexible fibers in steatite. Middlefield (Emmons).

Ligniform, white and yellowish-white fibers, stiff and brittle, traversing serpentine in vein at Middlefield (Emmons).

Compact in Middlefield with serpentine.

C. Dewey: Geol. Berkshire; Am. Jour. Sci., Vol. VIII, p. 47.

1824. **Serpentine.** Middlefield, Worthington, Plainfield.

Bed 2 miles long, 2 miles south of the meetinghouse in Middlefield; light and dark green. In neighboring brook white and cream colored; spotted, translucent, beautiful. Both precious and common. In Russell, a little east of south of above, large beds dark-green; has been polished for marble. In Middlefield, east of meetinghouse, connected with great bed of steatite; also Worthington and Plainfield.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 49.

1824. **"Vert antique?"**

A magnesian mineral found in a bed in gneiss on the river in Becket and colored greenish by serpentine. It may, as Dr. Emmons thinks, be a serpentine marble; tough, takes fine polish; effervesces, often yellowish-white.

C. Dewey: Geol. Berkshire County; ibid., p. 58.

(This is the Coles Brook pre-Cambrian chondrodite limestone, which is often partly altered to serpentine.)

1825. **Serpentine.** At the foot of the mountain west of Westfield.

Emerson Davis: Min. Not.; ibid., Vol. IX, p. 252.

1825. **Pimelite.** Middlefield.

At locality of crystallized steatite. (See Pimelite, p. 122.)

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 609.

1825. **Serpentine.** Zoar, Worthington, Deerfield River.

Robinson's Cat., p. 78.

1826. **Serpentine.**

On the mountain 5 miles west of Westfield Academy are two beds of serpentine, one not before mentioned; in mica-slate with limestone at south end of bed and in terstratified with serpentine at right angles, or 90°.

Serpentine intercalates and alternates with an unknown mineral resembling lime 1 inch in thickness; sometimes they are blended. Vein contains schorl and actinolite. A cross section of the bed is as follows: Green talc, serpentine, unknown mineral, serpentine, green talc. On the opposite side of the river, 1 mile north of this, another bed—mentioned by Eaton in Index (Am. Jour. Sci., 1st series, Vol. VI, p. 227, Hitchcock). In mica slate, not in granite. Black, greenish on thin edges, foliated, laminæ with luster of hornblende; sp. gr. 2.6; powder attracted by magnet; proposes variety name "magnetic serpentine." A yellow-green, foliated mineral occurs in the serpentine—probably sahlite. On the Westfield River bank between these localities are bowlders of tons weight of talc with fragments of black serpentine containing 4-sided prisms, hair-brown—anthophyllite?

Emerson Davis: Rocks and minerals of Westfield; Am. Jour. Sci., 1st series, Vol. X, p. 213.

1826. **Serpentine**—Continued.

The first of these localities is Munns Brook, and the unknown mineral is enstatite. The second locality is Atwater's quarry and the mineral bastite (marmolite). The third mineral is enstatite.

1832. **Serpentine.**

Middlefield, south part; one-fourth mile in breadth, 2 miles long in north part, with steatite; precious and common. Blandford, three beds. Westfield, west part, going into Russell, dark, with green talc; has been worked. Pelham, southwest part; dark, much talc. Zoar, southeast side Deerfield River, near turnpike.

E. Hitchcock: Geol. Mass.; ibid., Vol. XXII, p. 30.

1833. **Serpentine.** Zoar, Blandford, Middlefield.

E. Hitchcock: Geol. Mass., p. 30.

1835. **Serpentine.** Zoar, Blandford, Middlefield (two localities).

Blandford, 4 miles northwest of the church on the northeast side of North Meadow Pond; discovered about 1834 by Mr. Simeon Shurtleff (Geol. Mass., p. 305); 30 rods in diameter; stratified; on west, hornblende schist; also 4 or 5 miles south, 40 rods east of soapstone quarry (Osburn's); also bowlders of peculiar green serpentine with talc and schiller spar on east line of town. Westfield, in mica-slate, 4 rods wide, black with talc, scapolite (?), massive garnet, amphibole, and calcite. Russell, apparently in continuation of above, on north bank of Westfield River, black and green with deweylite. Pelham, with talc and asbestos in gneiss. Shutesbury, black, mostly steatite. New Salem, steatite passes into black serpentine in gneiss.

E. Hitchcock: Geol. Mass., pp. 30, 367 ff.

1841. **Serpentine.**

Nearly all above localities cited, especially page 614—a compact topographical résumé. Middlefield and Becket, in cuttings on railroad; a delicate variety mixed with the limestone.

E. Hitchcock: Geol. Mass., Final Report, pp. 159, 567, 610, 614.

1841. **Amianthus.** Russell, in serpentine.

E. Hitchcock: Geol. Mass., p. 618.

1844. **Serpentine.** Westfield, Russell, Blandford, Chester, Middlefield, Charlemont, Zoar.

E. Hitchcock: Ex. Geol. Map, p. 12.

1844. **Serpentine** (*Ophitis communis*). Blandford, Middlefield, Westfield.

J. D. Dana: Sys. Min., p. 309.

1876. **Serpentite.** Chester and Middlefield.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 3.

1876. **Picroline.** Middlefield; Chester.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 3.

1882. **Serpentine.** Russell.

Black serpentine with bastite. Analysis by Prof. C. U. Shepard. Sp. gr. 2.60; H. 5.

SiO_2	44.16
MgO	37.44
FeO	7.05
H_2O	11.00
	99.65

1892. **Picrolite.** Chester.

Beautiful deep leek-green; fibrous, the fibers not easily separating; on alteration becoming colorless, and developing a pearly luster and a micaceous or talcky cleavage, and at the surface changed into a fine tough-fibered serpentine—asbestos. Exposed in a bed several feet across in the railroad cutting at the first bridge north of the Chester station. This is widely separated from the large Chester-Middlefield band.

1893. **Serpentine.**

The series of great serpentine beds which extends across the State from Rowe to Granville is of more lithological than mineralogical interest, and is treated at length in the monograph on the geology of the area. A detailed microscopical study failed to detect any trace of olivine or of olivine structure in any of the beds except the eastern Osborn bed.

The eastern line of beds, from Munns Brook in Granville to Osborn's quarry in Blandford, is derived from coarse enstatite rock. The lower bed at Osborn's quarry is from a coarse pyroxène rock. The long line of beds from Blandford north to Rowe are derived from hornblende-schist, and where the road from Chester to Middlefield crosses the bed one sees the most perfect pseudomorph of serpentine after hornblende-schist imaginable, every detail of structure of the hornblende schist south of the river being repeated on the surface of the vertical walls of serpentine, while on breaking into the mass only the black massive serpentine appears, without a trace of schistose structure. After a long and careful search had failed to find any trace of olivine in these serpentines, I was surprised to find in the so-called serpentine pseudomorphs after quartz from the Middlefield bed pseudomorphs after olivine of large size and great beauty. I have therefore given the history of these forms separately under the name hampshirite (q. v.), although the material is not proved to be a distinct species.

East of the river all the serpentines in Pelham and Shutesbury are derived from olivine.

1894. **Serpentine pseudomorphs after olivine** (formerly called quartz pseudomorphs). Middlefield.

A specimen, presumably unique, was shown, having several large attached crystals more than an inch long, showing the common forms of olivine now changed into a pale yellow serpentine, closely resembling the Snarum forms. The crystals have long been cited as quartz pseudomorphs from Middlefield, but the locality has been lost for many years. This specimen is from the collection of Mr. James Clark, formerly of Brooklyn, and now belongs to Smith College. Its label states that the locality was on the brook which crosses the great serpentine bed in Middlefield, and that it was purposely covered up by someone many years ago.

B. K. Emerson: Bull. Am. Geol. Soc., Vol. VI, p. 473.

1895. **Serpentine.**

Analyses of serpentines.

[Nos. 1-5 by Mr. George Steiger, in the laboratory of the Survey; No. 6 by Miss H. P. Cook, instructor in chemistry in Smith College.]

	1.	2.	3.	4.	5.	6.
SiO_2	37.82	40.42	36.94	39.14	33.87	40.27
TiO_2	Trace.	None.	Trace.	None.	None.	....
Al_2O_3	.61	1.86	.50	1.18	.77	5.74
Fe_2O_3	7.92	2.75	6.04	4.46	2.81	
FeO	1.15	4.27	1.94	3.14	4.25	....
FeS_2	....	.43	....	....	....	....
Cr_2O_3	.19	.28	.33	.33	.38	....
NiO	.45	.53	.40	.47	.33	....
CoO	.05	Trace.	None.	Trace.		....
MnO	....	Trace.	Trace.	None.	.04	....
CaO	None.	.66	None.	None.	None.	....
BaO	None.	None.	None.	None.	None.	....
MgO	37.94	35.95	38.33	41.45	38.57	40.00
K_2O	Trace.	Trace.	None.	None.	None.	....
Na_2O						
H_2O-100	.75	.21	.71	.34	.38	.69
H_2O+100	12.50	10.51	12.07	9.48	7.00	13.61
SO_3	....	Trace.	.20	None.	.20	....
P_2O_5	Trace.	Trace.	Trace.	.02	Trace.	....
CO_2	....	1.44	1.85	None.	10.82	....
	99.38	99.31	99.31	100.01	99.42	100.31

No. 1. Enstatite changed to serpentine. Granville. H. Cooley's.

No. 2. Rich dark-green serpentine. Rowe. Quarry near R. King.

No. 3. Black serpentine containing marmolite (bastite). Russell. Atwater's quarry.

No. 4. Black-green serpentine, weathering to pale nickel-green with much chromite. North Blandford, from "The Crater."

No. 5. Gray splintery serpentine enveloped in talc. Chester. From the east wall of the old mine.

No. 6. Straw-yellow fibrous serpentine, glazed, enveloping olivine pseudomorphs. Middlefield. From the specimen figured; Plate I.

SILLIMANITE.

1876. **Fibrolite.** Northfield, Sillimanin, Chester.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 6.

(The Northfield specimens are in bowlders from New Hampshire.)

1878. **Sillimanite.** Palmer.

Prisms not well formed, but standing out from their marked cleavage.

Groth: Min. Sammlung, Strasburg.

The specimen was doubtless from a bowlder from the range of fibrolite rock in the granite in Belchertown.

1881. **Fibrolite.** Amherst.

In the feldspathic mica-schist along the west of the ridge on which the village is built from the college grove to the Agricultural College; the rock is spangled in cleavage faces with large (one-half inch) equidistant blotches of shining white muscovite, shot through with blades of fibrolite. This changes with the rest of the rock into an amber-colored, soft agalmatolite (?).

1883. **Sillimanite.** Belchertown, Enfield.

In the east portion of Belchertown, at house of Mr. J. Clough, commences a great mass of sillimanite gneiss, forming an inclusion in the tonalite. Crystals, square prisms up to 1 inch long.

1885. **Sillimanite.** East Brimfield. Near house of William Lombard.

The coarsest specimens found in fissures in calcareous pyroxenite, 45 mm. long, 5 mm. wide.

1891. **Fibrolite.** Warwick, south of Harris's soapstone quarry.

In pure white straight fibrous masses of great beauty and large size, resembling pycnite. It occurs in coarse granite on the border of fibrolite schist, and seems, as is often the case, to have been dissolved out of the country rock and concentrated by recrystallization in the pegmatite in purer form. It is the characteristic mineral of the Brimfield schist, which occupies the eastern portion of our area and extends over a large part of Worcester County.

SIDERITE.

1835. **Lenticular carbonate of iron.** South Island, Turners Falls.

For several rods around copper vein, numerous crystals.

E. Hitchcock: Geol. Mass., p. 226.

1858. **Chalybite.** Turners Falls, South Hadley Falls.

E. Hitchcock: Catalogue of State collection; Nos. 111, 112, 6th Report State Board of Agri., p. xx.

(The piece from Turners Falls shows a surface of Triassic sandstone, incrusted with fine, large rhombohedra—½ R, now changed to limonite. In the specimen from South Hadley Falls fissures in red Triassic sandstone are incrusted with shining red crystals, shot through by long needles of a white mineral, which has now almost wholly disappeared. The specimens are in the survey collection of Massachusetts, made by President Hitchcock, and deposited in the Amherst College Museum.)

1859. **Spathic iron.** Goshen.

With zoisite and specular iron in mica-slate.

E. Hitchcock: Final Cat. State Col. No. 17, Mass. Agr. Rep., App., p. xl.

See Ankerite.

SILVER.

1810. **Silver.**

Loudville, 12½ ounces to the ton.

B. Silliman: Bruce's Jour., Vol. I, p. 69.

1841. **Silver.** Southampton.

A chapter on "Misguided efforts in search of gold and silver."

E. Hitchcock: Geol. Mass., p. 206.

SPHALERITE.

1810. **Blende.** Loudville, Southampton.

Crystals on quartz.

B. Silliman: Bruce's Jour., Vol. I, p. 68.

1823. **Sulphuret of zinc.**

Loudville, foliated and crystallized. Leverett, foliated.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 235.

1827. **Blende.** Hatfield and Leverett.

A. Nash: Lead mines of Hampshire County; ibid., Vol. XII, p. 258.

1835. **Blende.** West Springfield.

In fetid limestone in Paine's quarry and Meacham's quarry; rare. (Triassic.)

E. Hitchcock: Geol. Mass., p. 230.

1838. **Blende.** Russell, Norwich.

Russell, farm of John Gould. Norwich, farm of Quartus Angell. (In quartz veins in Conway schist.)

E. Hitchcock: Econ. Geol., p. 127.

1841. **Blende.** Northampton, Norwich (now Huntington).

The principal ore in vein in Northampton 1 mile northeast of the Loudville vein. (Both baryta-lead veins in granite.) In Norwich 1 mile northeast of the meetinghouse; opened by Quartus Angell; elegant quartz.

E. Hitchcock: Geol. Mass., p. 204.

1844. **Zinc.** Northampton, Norwich.

E. Hitchcock: Explanation of Geol. Map, p. 22.

1859. **Blende in quartz.** Norwich, Holyoke.

Large mass in State collection in Amherst College; from Angell's mine. Cat. No. 200, p. xix.

Fine, transparent cleavage pieces in fissures in clayey limestone. (Trias.) Holyoke. Cat. No. 107, p. xlix. Ibid.

Rep. Agri. of Mass. for 1858, App. lxix.

1882. **Sphalerite.**

Rarely in red-brown grains 5 to 6 mm. long, fresh looking and of high luster in the interior, but generally surrounded by a bright-red rust layer. In prehnite, epidote, and calcite, and in the light-gray diabase, filling cavities lined with diabantite, with curious many-faceted globules.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 350.

1883. **Sphalerite.** Leverett. East mine.

In fine transparent olive-green, complexly twinned crystals nearly an inch across. Found by Mr. E. J. Whitaker, of the class of 1883, Amherst College, and deposited in the college cabinet. From baryta-lead veins in granite.

1891. **Sphalerite.** Hatfield.

Occurs rarely in fine druses of black crystals, in part transparent, and then oil-green; complex twins, mainly ∞ O and O. The blende and the barite together coat the walls of the veins, and quartz follows. From baryta-lead veins in tonalite.

1894. **Sphalerite.** Sunderland.

Large transparent wine-yellow pieces in fetid concretionary limestone at the fossil fish locality in black Triassic sandstone at Whitmore's Ferry.

SPINEL.

1892. **Spinel.** "Near Springfield, Mass."

"Octahedral crystals tesselated like chiastolite," embedded in slate.

E. S. Dana: Sys. Min., p. 222.

These are skeleton crystals of salt, now pseudomorph by replacement in calcite, and occur in the black Triassic shale at West Springfield. (See Salt.)

SPODUMENE.

1823. **Augite.**

Goshen, in granite. Flattened, greenish-gray prisms, sometimes 8 inches long and 2 inches wide, 1 mile north of meetinghouse on Ashfield road.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 225.

1824. **Spodumene.** Vicinity of Conway.

Partially analyzed, light-green color.

George T. Bowen: Jour. Acad. Nat. Sci., Philadelphia; also Am. Jour. Sci., 1st series, Vol. VIII, p. 120.

1824. **White augite.** Goshen.

At the celebrated locality of indicolite.

J. Porter: Loc. Min., p. 233.

1824. **Spodumene?** Chester.

In small quantity in granite.

"By the action of the blowpipe it is first converted into scales or plates, which then melt into a glass; brittle, scratches glass, yellowish or pale green."

C. Dewey: Geol. Berkshire County; Supp. Am. Jour. Sci., 1st series, Vol. VIII, p. 243.

1825. **Spodumene.** Goshen.

"The mineral already described (Am. Jour. Sci., 1st series, Vol. VI, p. 225, Vol. VII, p. 30) as white augite turns out to be spodumene. It exists in various parts of Goshen, especially the northern part. Not as yet noticed in place, but the granite bowlders are so massed that they certainly are the upper portion of a great bed beneath."

E. Hitchcock: Loc. Min.; ibid., Vol. IX, p. 20.

1825. **Spodumene.** Goshen.

"The white augite mentioned in American Journal of Science (1st series, Vol. VIII, p. 233) is I believe, spodumene. Correction."

J. Porter: Min. Not.; ibid., p. 55.

1825. **Spodumene.** Goshen.

"At the celebrated tourmaline locality and several other places."

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 607.

1828. **Spodumene.** Norwich (Huntington).

"Was conducted to hill near the north line of Norwich, where I found spodumene in large laminated masses."

E. Hitchcock: Am. Jour. Sci., Vol. XIV, p. 220.

1831. **Spodumene.** Chesterfield.

In coarse granite with beryl near celebrated tourmaline locality. Crystals large, often apple-green.

J. Porter: Loc. Min.; Am. Jour. Sci., 1st series, Vol. XX, p. 170.

1841. **Spodumene.**

Goshen, most abundant; 2 miles north of village on the Ashfield road; 3 miles northeast on the Plainfield road. Chesterfield, Norwich, Chester; prisms from Chesterfield 21 inches long, though broken at both ends (Dr. Dwight, Cummington); white or gray; small specimens delicate green or light rose.

E. Hitchcock: Geol. Mass., p. 701.

1844. **Spodumene.** (*Petalus triphanus.*) Goshen, Chesterfield, Chester.

J. D. Dana: Sys. Min., p. 360.

1850. **Spodumene.** Norwich.

Analysis.	I.	II.
SiO_2	63.06	62.72
Al_2O_3	28.00	28.85
CaO	.95	1.13
LiO	5.67	5.67
NaO	2.51	2.51
	100.19	100.88

G. J. Brush: Am. Jour. Sci., 2d series, Vol. X, p. 370.

1850. **Spodumene.** Norwich.

A crystal belonging to Mr. Charles Hartwell was noticed by him at the meeting of the American Association for the Advancement of Science, 1849. On examination Professor Dana finds that the mineral is monoclinic and isomorphic with pyroxene. The crystal is described and figured and measurements are given, and the formula given is $0 P, \infty P, \infty P \infty, \infty P \infty, \infty P' \infty, P, 2 P, 2 P' \infty, 3 P 3$ (?), $m P n$; another crystal has the faces $0 P$, $3 P 3$, $m P n$ wanting; gives strong lithia reaction. Formula $R_3,Si_2O_3 + 4Al_2O_3Si_2O_3$ (Kobell).

NOTE.—The spodumene of Conway in the same range was tested for lithia successfully in 1824 by G. T. Bowen.

J. D. Dana: Ibid., p. 119.

1853. **Spodumene.** Norwich.

Reanalyzed as follows:

	No. 1.	No. 2.	No. 3.
SiO_2	64.04	63.65	63.90
Al_2O_3	27.84	28.97	28.70
Fe_2O_3	.64		
CaO	.34	.31	.26
Mgo	Trace.	Trace.	Trace.
Li_2O	5.20	5.05	4.99
Na_2O	.66	.82	.80
K_2O	.16		
Ignition	.50	.50	.60
	99.38	99.30	99.25

Smith and Brush: Ibid., Vol. XVI, p. 371.

1865. **Spodumene.** Huntington.

Mr. F. R. Allen of the class of '65, Amherst, found a large bowlder of spodumene granite at the west foot of Walnut Hill, with many crystals of a type unusual for the region. Small square prisms very fresh and well terminated. The specimens have been presented to Amherst College.

1866. **Spodumene.** Winchester, N. H.

Just over the line. Continuation of Goshen formation, on land of Mr. Brown, under barn and in brook-bed near bridge; cleavable masses; most northern location of the species.

C. U. Shepard: Ibid., Vol. XLII, p. 248.

(The term "Goshen formation" refers to the albitic tourmaline granites of Goshen.)

1876. **Spodumene.** Goshen.

North of Lily Pond in the north of Goshen is a heavy bluff of biotite granite, and a few rods north is a large bedded dike of muscovite granite. In this I found, in 1876, pseudomorphs of muscovite after spodumene 2 inches broad by 6 inches long, and recognized them then as such.

1876. **Spodumenite.** Goshen, Huntington (formerly Norwich).

C. U. Shepard: Cat. of Min. within 75 miles of Amherst, p. 5.

1878. **Spodumene.** Norwich.

Analysis affording formula: Li_2,Al_2,Si_4,O_{12}.

C. Doelter: Ueber Spodumene und Petalite; Min. Mit., Vol. I, p. 517.

1879. **Spodumene.** Goshen, Chesterfield, Huntington.

Goshen, Manning farm. Imperfect bladed crystals up to 2 inches across in coarse aggregate of albite, indicolite, and garnet.

1879. **Spodmene**—Continued.

Barras farm. Rectangular crystals up to 18 inches long, often changed to cymatolite. The well-known tourmaline locality, Chesterfield.

A. Macomber farm; northwest corner of town, 2 miles southeast of village of East Cummington; first opened by Professor Julien in 1870. Clark ledge, the well-known locality of colored tourmalines, contains no spodumene.

West Chesterfield Hollow. Isinglass rock; crystals up to 35 inches long, 10 to 11 inches across, changed to cymatolite, albitic granite, quartz. Vein worked three summers by Professor Julien. Four miles farther south in Huntington (formerly Norwich), on Walnut Hill; the vein which has furnished the finest crystals up to 16 inches long. Chester, 1 mile north of village; opened by Emmons.

Manning farm. Coarse aggregate of albite, indicolite, garnet, and spodumene; where crowded and imperfect grains indicate a more rapid crystallization than in the other localities.

Barras farm. Main vein orthoclase; granite with beryl; central band or secondary vein of cleavelandite and gray-white quartz with spodumene and tourmaline, beryl green and white, garnet, muscovite, columbite, cassiterite—apparently a later deposition of quartz.

Macomber farm. First vein the same; in secondary, 1st, quartz, muscovite, granular albite, tourmaline, spodumene; 2d, cleavelandite, quartz, magnetite, garnet, zircon; 3d, smoky quartz, green and black tourmaline. The larger crystals penetrate through all the formations.

Clark's. Same, no spodumene; 1st, albitic granite, little quartz and muscovite, black tourmaline and garnet; 2d, cleavelandite, black, green, and brown tourmaline, microclin, columbite, cassiterite, zircon, cookeite, lepidolite; 3d, center, smoky quartz.

Chesterfield Hollow. Granite, no beryl, little mica; 1st, orthoclase, huge crystals, 6 to 10 inches; green and white quartz; 2d, albitic granite, green muscovite, spodumene, green, white, and black, 10 to 25 pounds; quartz, columbite, masses one-half pound in weight, zircon, rich in uranium; 3d, quartz and cleavelandite; 4th, magnetite, quartz, zircon, spodumene, yellowish, white, and black; 5th, smoky quartz, green spodumene, green and black muscovite, 2 to 3 inches; columbite, zircon.

Walnut Hill. First, muscovite, granite; 2d, albitic orthoclase, black tourmaline, muscovite, garnet, magnetic quartz; 3d, cleavelandite, with quartz, spodumene, tourmaline, tripolite, cyrtolite, quartz, apatite, muscovite, green, white, and black; 4th, spodumene, muscovite, granite, biotite, magnetite, cyrtolite.

A. A. Julien: Ann. N. Y. Acad. Sci. Arts, Vol. I, pp. 316, 350.

(The article contains careful analyses and a full discussion of them, establishing independently of Doelter the same formula. The paragenesis of the mineral and its alterations into killinite, cymatolite, vein granite, and quartz, are fully described (see p. 115), making this the most valuable article that has been published upon the granitic veins which carry rare minerals in our western hills.)

1885. **Spodumene.** Huntington.

The old locality on Norwich Hill was opened for me in the summer of 1884 by Mr. Frank L. Nason, at a point a little north from the old opening. Very large crystals, the largest 29 by 7½ by 3¾ inches, were found, rarely well terminated, and of a clear gray color without the slight flesh color of some of the older crystals. They were covered with dendrites. Several fine twins, twinned parallel to $\infty P \infty$, were found. The great crystals are

1885. **Spodmene**—Continued.

often crushed, the parts much slipped on each other, being sheared many times by a force acting about at right angles to the vertical axis, and then recemented; slipping often 2 to 10 mm. They are also often bent, one 16 by 4½ by 2 inches is bent 45° without breaking. Another, the largest obtained, is broken or thus bent more than 40 times, the breaks often changing into flexures, and the whole is firmly recemented. (See fig. 5.)

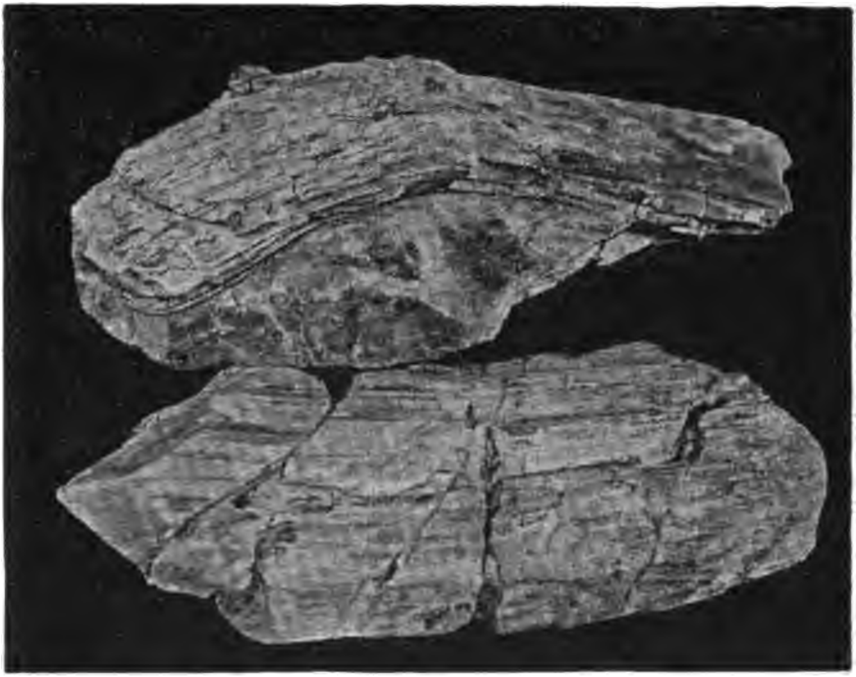


FIG. 5.—Bent and faulted crystals of spodumene from Walnut Hill, Huntington, × ½. The lower crystal has been faulted several times and recemented in the ledge. The upper one has several small monoclinal folds.

1889. **Spodumene.** Goshen.

Mr. Alvan Barras has been excavating the spodumene in very large quantities a mile northeast of his house, opposite the sawmill at J. B. Taylor's, and New York capitalists have done some blasting at the Manning locality about a mile farther east. Samples have been sent to Paris to see if lithium could be profitably obtained from it.

1890. **Spodumene.** Chesterfield.

The best crystal of spodumene from Chesterfield—I presume from West Chesterfield Hollow—is in the collection of Columbia College, collected by Mr. A. A. Julien. It is a terminated crystal about 35 by 12 mm. in cross-section.

1890. **Spodumene.** Huntington.

Dr. E. Hitchcock sold the finest crystal ever obtained from Norwich Hill for $50 to W. J. Knowlton, of Boston. I can not discover its present owner.

1894. **Spodumene.** Chester, Huntington, Goshen.

In a quartz vein in mica-schist implanted in albite.

C. Hinze: Handb. Min., p. 1121.

(All the occurrences of spodumene are in coarse pegmatite veins in mica-schist. Within these pegmatite veins the minerals containing rare elements are found in secondary veins of albitic granite, which often have a zonal arrangement with a center of smoky quartz, into which the large spodumenes sometimes project, and are then terminated.

These pegmatite veins form an outer fringe of dikes around the great central stock of granite.)

STAUROLITE.

1819. **Staurotide.** Northfield.

In mica-slate 1 mile east of village, on Boston turnpike; six-sided prisms; also garnets.

E. Hitchcock: Sup. Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 436.

1823. **Staurotide.**

Everywhere across the State in the eastern range of mica-slate. North Wilbraham, Ludlow, Shutesbury, Leverett, Northfield.

In abundance in the western range of mica-slate in Chesterfield, Cummington, Plainfield, Hawley. In Chesterfield a mica-slate band 2 or 3 feet thick contains seven or eight distinct layers.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 219.

(I doubt the occurrence of the mineral in any of the eastern range of towns, except Northfield.)

1824. **Staurotide.** Norwich.

Abundant in mica-slate.

E. Emmons: Ibid., Vol. VII, p. 254.

1824. **Staurotide.** Very common in towns about Middlefield (Emmons).

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 40.

1841. **Staurotide.** In mica-slate in Norwich, Chesterfield, Goshen, Hawley, and Heath.

E. Hitchcock: Geol. Mass., p. 593.

1844. **Staurotide.** (*Carbunculus decussatus.*) Chesterfield.

J. D. Dana: Sys. Min., p. 385.

1861. **Staurolith.** Chesterfield.

Large black and brownish-black crystals, accompanied by light and dark mica and albite. Sp. gr. 3.772.

SiO_2	28.86
Al_2O_3	49.19
Fe_2O_3	3.20
FeO	13.32
MnO	1.28
MgO	2.24
H_2O	.43
	98.52

C. Rammelsberg: Pogg. Ann., Vol. CXIII, p. 599.

1877. **Staurolite.**

Blandford, east of Blairs Pond, in feldspathic mica-schist. The best cabinet specimens occur here in both forms of twinning. The mineral is confined to the Goshen and Conway schists and to the Devonian mica-schists of the Bernardston series in their more eastern and northern extension, especially around South Vernon.

1885. **Staurolite.** Whately.

Exquisite microscopical twins occur, forming with muscovite pseudomorphs after chiastolite in the argillite at contact with the tonalite.

1894. **Staurolite.**

The analysis of 1861, cited above, is quoted as "angeblich aus Massachusetts (Chesterfield?)."

C. Rammelsberg: Neues Jahrbuch; Beilage-Band IX, p. 480.

STIBNITE.

1823. **Sulphuret of antimony.** Near South Hadley (Gibbs).

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 236.

1825. **Sulphuret of antimony.**

Cleaveland's Min., p. 688.

1825. **Sulphuret of antimony.**

Robinson's Cat., p. 70.
(A doubtful occurrence.)

STILBITE.

1818. **Stilbite.** Deerfield.

Not abundant; associated with chabasite; crystals small, well defined.
E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1823. **Stilbite.** Deerfield.

Crystals appear to be right prisms, whose bases are rhombs, with angles about 60° and 120°; rarely exceed one-tenth inch. Often grouped in foliated masses.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 224.

1824. **Stilbite.** Chester.

With chabasie in single, oblique, four-sided prisms with rhomboidal terminations, and grouped sometimes in bundles and globular masses and radiating from a center. Called zeolite by Professor Dewey, but does not gelatinize with acids. In fissures of veins in mica-slate about 1 mile east of meetinghouse in Chester.

E. Emmons: Loc. Min.; ibid, Vol. VII, p. 254.

1835. **Stilbite?** Goshen.

No. 1529 in State collection; a zeolite (?) on granite from Goshen.
E. Hitchcock: Geol. Mass., p. 507.

1841. **Zeolite(?).** Belchertown (Three Rivers).

In gneiss with prehnite.
E. Hitchcock: Geol. Mass., p. 639.
(Should be Palmer.)

1844. **Stilbite.** (*Zeolus fascicularis.*) Chester.

J. D. Dana: Sys. Min., p. 328.

1859. **Stilbite.** Goshen.

White fibrous, radiated on drusy quartz in fissure of fine-grained gneiss. Cat. Mass. Col., No. 159; Rep. on Agri. of Mass., for 1858, Appendix, p. lxviii.

1882. **Stilbite.** Chester.

On dark-gray fine-grained fresh gneiss; stout, square prisms, $\infty P \infty$, $\infty P \breve{\infty}$, $0 P$ with fluted sides and slightly rounded end; wine yellow; the single prisms graduate into openly radiated bundles with deep red-brown chabasite, the two growing together so as to show them to have been formed at the same time. Also twinned tubes and cubo-octahedrons of pyrite, the latter newer and one-eighth of an inch long. The fine specimen from which these notes were taken was destroyed in the burning of the Shepard collection. It came probably from the locality cited above by Emmons.

1882. **Stilbite.** Deerfield.

This occurs generally in separate narrow fissures with comparatively fresh walls, associated only with heulandite, chabazite, calcite, pyrite, and diabantite, but it is found sometimes resting on prehnite. It appears (*a*) in circular forms with radiated structure 10 to 20 mm. in diameter, and up to 2 mm. thick, either spread separately or aggregated so thickly as to cover the whole surface, or in small hemispheres; Farther south, opposite Deerfield, fine globular forms as large as a marble rest upon the gashed quartz, and secondly (*b*) in small stout scopiform crystals, $\infty P \infty$, $\infty P \breve{\infty}$, $0 P$, of dull yellow color. The first form occurs associated with calcite, and rarely chabazite; the second with heulandite and chabazite, and I examined a flat surface of the trap, 4 feet square, one-half of which was covered with radiated stilbite, at first thickly covering the surface, then separating into distinct disks, and then quite suddenly replaced along a straight line by heulandite with which was associated chabazite, and rarely the small prismatic crystals of stilbite. A third form of stilbite (*c*) is in interlaced crystals 4 mm. long, perfectly pellucid, with even. highly polished faces $\infty P \infty$, $\infty P \breve{\infty}$, $0 P$. Under the microscope the mineral shows a fine rigid lining parallel to $0 P$, which seems to mark lines of growth, and has no effect upon the polarization. At right angles to this run (1) long lines of flat water cavities, often negative forms in whole or part, or such forms many times repeated and indicating quite rapid crystallization, and (2) sharply marked lines of multiple twinning, the whole crystal being made of fine plates which increase in number from below upward, new plates being intercalated and old ones obliterated, as in a compound coral. The new plates sometimes appear as points and increase upward with curved faces, and sometimes the old crystal develops a P-face upon which the new one is based.

Products of the decomposition of stilbite.—Kaolin (?). Many broad surfaces of the trap are covered with snow-white stellate patches of stilbite, which show all stages of the decomposition of the mineral into kaolin (?). In specimens already become snow-white and opaque, the kaolin can be seen under the microscope in minute rounded scales and aggregations of these into beaded lines, which are crowded in between the laminæ of the stilbite, the latter showing no signs of change, but remaining limpid and polarizing apparently as vividly as in the freshest specimen. In other pieces where the change is nearly complete, the mass shows only aggregate polarization, and only traces of the stilbite remain.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 357.

1886. **Stilbite.** Monson.

From the north end of the Flynt quarry in gneiss. Incrusting broad surfaces with colorless radiated needles and small crystals; also in broad, laminated, flesh-colored mass filling a vein in the northwest of the quarry. Small colorless-bladed crystals in reticulated groups on chabazite.

1891. **Stilbite.** Orange, Buckland.

Orange: In broad flesh-colored radiations with prehnite on surfaces of Monson gneiss in the cutting east of the station. Buckland: In fissures in gneiss in the quarry on the railroad near Shelburne Falls, with chabasite, natrolite, epidote, and babingtonite.

STOLZITE.

1866. **Scheeletine.** Manhan lead mine, Southampton.

"This mineral was handed me for determination by Mr. Clark, of Northampton. He found the few unknown crystals occupying together a cellular quartz gangue, nearly one-half inch long and three-eighths of an inch in diameter; right square prisms, imperfectly terminated by acute hemihedral pyramids; the faces are not altogether plane, presenting a dissected or unfinished appearance. Color pale, wax yellow, passing into gray. The inner portions are grayish black, with shade of blue with submetallic luster; otherwise the luster is adamantine. Before the blowpipe it decrepitates slightly, melts easily, yielding lead and dark-gray globules with borax yellow while hot gray and opaque on cooling; with salt of phosphorus yellow while hot, colorless on cooling, with excess greenish-yellow while hot, opaque to grayish when cold; with NO_5 dissolves with yellow residue, which gives with metallic zinc the reaction for wolframium.

"As scheelite and cassiterite occur in Chesterfield, we may well be encouraged to persevere in efforts to find tin in workable quantity not far distant."

C. U. Shepard: Am. Jour. Sci., 2d series. Vol. XLI, p. 215.

1885. **Stolzite.**

The specimen upon which Professor Shepard made his observations was burned with his collection. The remaining specimens have passed with the Clark collection into the possession of Smith College, Northampton, and have the original label of Mr. Clark, with the note that it is the same that was submitted to Professor Shepard, and determined by him to be scheeletine. The best specimen contains several groups of small crystals, 3½ by 1½ mm. in cross-section, black, with metallic luster and peacock tarnish, which have smooth shining faces with the form P (111), $\frac{\infty P2}{2}$ $(\bar{1}20)$. The prism has striation parallel to the intersection with the pyramid and the form agrees exactly in proportion of parts with the crystals from Zinnwald (Naumann, Pogg. Ann., Vol. XXXIV, p. 373, pls. 3, 8; Quenstedt, Min., p. 499, fig. 3).

The largest crystals are formed by the partial coalescence of several of these long square prisms, resulting in stout square prisms with deep longitudinal grooves on the prismatic faces. Moreover, these long prismatic faces are built up of smaller crystals, which are not only in parallel position, but are of common size and arranged in vertical rows between the grooves mentioned above, and they terminate above and below in sharp pyramids, thus giving the whole a peculiarly ornate gothic appearance. In part the black color extends to the surface in these larger crystals; in part, and especially toward the end, they are dull wax yellow. The partial

1885. **Stolzite**—Continued.

crystals present a greater complexity of form; the combinations P (111), $\frac{\infty P 3}{2}$ (π 120), $\frac{2 P \frac{4}{3}}{2}$ (π 342). P (111), $\frac{\infty P 3}{2}$ (π 120), P $\propto$ (101). P (111), P ∞ (101), ∞ P 2 (120), $\frac{3 P 3}{2}$ (π 131). P is rough, as if regularly picked with a needle point, P ∞ smooth, shining; ∞ P 3 smooth, rounded; P 3 rough. The crystal showing the latter combination is remarkable for showing ∞ P 2 holohedral and for a beautiful hemihedrism; all the pinnacles at one end of the big prism running out in P, ∞ P; on the other end in P alone, with two opposite faces so developed that the pinacles all end chisel-shaped. It shows thus the same development as Naumann (loc. cit., fig. 10, fig. 4; Quenstedt, Min., p. 499), and isolated crystals of this form also occur, which have ∞ P 2 hemihedral and all the faces developed in the same relative proportion as in Naumann's fig. 10.

The large crystals are coated by a great number of minute reddish-yellow crystals, which sometimes form a crust upon them, which on ground of imperfect blowpipe diagnosis were thought to be vanadinite by Professor Shepard. They are in parallel position with the larger crystal, and a careful examination with a strong lens shows that they have the same crystalline form—the ground pyramid with a rounded trito prism. They are, therefore, a second generation of stolzite or a later incrustation of wolfenite. With the common isomorphism and common occurrence of the two species, it is not easy to say which is the fact. The reddish-yellow color is that of the later wulfenites of the locality.

There is a specimen from Loudville in the Clark collection, nearly a decimeter square, of a massive black mineral, very heavy, with conchoidal fracture, pitchy luster, resembling black pitchstone or pitchblende.

It is delicately veined with white cerussite, and on the reverse side runs out into the quartz in stout-square prisms much like those of stolzite, which the mineral resembles strongly. It is labeled by Mr. Clark "marasmolite, Professor Shepard thinks, or perhaps copper glance," and on a separate label "black cerussite," but it proves on analysis to be stolzite.

SULPHUR.

1818. **Sulphur.** Conway, Shelburne, and Warwick.

On mica-slate.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1823. **Sulphur.**

Pulverulent; perhaps from decomposition of some sulphuret.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 230.

1824. **Sulphur.** Cummington.

In the singular mineral discovered by Dr. Porter (cummingtonite, Dewey). Also Middlefield and Chester (Emmons) in rock with bright-green mica.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 54.

1882. **Sulphur.** Northfield.

In cavities in decomposing pyrite layers in hornblendic gneiss on sharp east slope of Trowbridge Hill, on north line of State, in minute crystals.

1883. **Sulphur.** Leverett.

In hornblende-schist in drusy cavities lined with beautiful minute crystals.

1895. **Sulphur.** Hatfield.

At the lead mine in small globules on altered galena.

TALC.

1818. **Steatite.** Shutesbury.

(Localities said to be given on map which accompanied the article in first and second editions of this volume of the Journal, but not the later ones. I have not seen it.)

Indian pots, pipes, etc.

E. Hitchcock: Geol. Deerfield dyke; Am. Jour. Sci., 1st series, Vol. I, p. 113.

1818. **Soapstone.** Southampton lead mine.

At 670 feet in on the tunnel.

"Beautiful green soapstone, very compact, but rather softer than that kind used for inkstands."

A. Eaton: Am. Jour. Sci., Vol. I, p. 138.

1820. **Soapstone.** Middlefield.

Discovered by E. Emmons.

Professor Dewey: Ibid., Vol. II, p. 236.

1821. **Soapstone, magnesian stone.** Middlefield.

"A quarry of this species of stone at Plainfield, in the west of Hampshire, has been wrought to a considerable extent. I have seen a house faced with it in Northampton." (On Round Hill, occupied by Clark Institute. Should be Middlefield. See 1826, below.)

Dwight's Travels, Vol. 1, p. 34.

1821. **Steatite.** Loudville, with barite.

Cleaveland's Min., Vol. I, p. 437.

1822. **Crystalline steatite.** Middlefield.

C. Dewey: Am. Jour. Sci., 1st series, Vol. IV, p. 274; Vol. V, p. 249.

1823. **Crystalline steatite.**

Ibid., Vol. VI, p. 334.

The above citations refer to crystals of serpentine after olivine; see Chrysolite.

1823. **Steatite.**

Southampton (Cleaveland). Middlefield, in steatite (Dewey). Pelham, Rowe. Cummington (J. Porter). New Salem, bed in gneiss.

E. Hitchcock: Geol. Conn. River; ibid, p. 228.

1824. **Steatite.**

Middlefield, white, green white, deep green, large folia. Chester, brown talc forming veins in mica slate (Emmons). Large bed 2 miles east of the meetinghouse; extensively quarried and transported to Boston as freestone. Also at Worthington.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 51.

1825. **Steatite.** Zoar.

In serpentine.

Robinson's Cat., p. 78.

Zoar is a village in Charlemont. The soapstone is across the line, in Rowe.

1826. **Soapstone.**

"The house on Round Hill, in Northampton, mentioned by President Dwight, is built of soapstone—not from Plainfield, where the rock does not occur, but, as the owner informed me, principally from Middlefield."

J. Porter: Min. Not.; Am. Jour. Sci., 1st series, Vol. X, p. 19.

1827. **Talc in steatite.** Cummington.

One-half mile north of Hubbard's leather manufactory.

A. Nash: Lead mines of Hampshire County; ibid., Vol. XII, p. 260.

1828. **Steatite.** West Granville.

Good bed 1 or two miles southeast of meeting-house.

E. Hitchcock: Ibid., Vol. XIV, p. 222.

1832. **Steatite.**

Rowe, white and deep green. Shutesbury, south part. Wendell, south part. New Salem, 2 miles east of village.

Not so good on east as on west side of river.

E. Hitchcock: Geol. Mass.; ibid., Vol. XXII, p. 32.

(The Wendell occurrence is a large bowlder northwest of Locks Pond.)

1833. **Steatite.**

Middlefield, northeast part; one of the finest beds in the State; contains dolomite. Blandford, wrought. Granville, two beds. Zoar, two varieties—white and deep green. Rowe, two varieties.

E. Hitchcock: Geol Mass., p. 32.

1835. **Steatite.** Middlefield.

Mr. William H. Butler has just opened a new quarry there.

Ed. note: Am. Jour. Sci., Vol. XXVII, p. 382.

1835. **Steatite.** Rowe, Zoar, Middlefield, Granville, Shutesbury, New Salem.

In gneiss.

E. Hitchcock: Geol. Mass., p. 357.

1841. **Steatite.** Above localities.

Middlefield, delicate green. The variety of talc called nacrite, one-half mile west of the meetinghouse; in talcose slate.

Ibid., pp. 610, 613.

1844. **Steatite.** Above localities.

E. Hitchcock: Ex. Geol. Map.

1876. **Talcite.** Rowe, Chester, Zoar.

C. U. Shepard; Cat. of Min. within 75 miles of Amherst.

1891. **Steatite.** Richmond, N. H. Harris's quarry.

In beautiful coarse radiated masses and in large amount, derived from the alteration of the anthophyllite (gedrite) described on page 86. It is quarried extensively and carried to Athol, where it is worked.

TETRAHEDRITE.

1835. **Gray copper**

"I have seen a specimen from Brimfield; I infer that it originated from gneiss."

E. Hitchcock: Geol. Mass., p. 399.

Doubtful occurrence.

THOMSONITE.

1841. See Natrolite.

TITANITE.

1824. **Silico-calcareous oxide of titanium.** Chester.

Imperfect prisms, light brown, with augite and actinolite; also in syenite.

E. Emmons: Loc. Min.; Am. Jour. Sci., 1st series, Vol. VII, p. 254.

1824. **Silico-calcareous oxide of titanium.** Middlefield.

Imperfect prisms, rather lighter colored, but much resembling that of Brattleboro, Vt.

C. Dewey: Geol. Berkshire County; ibid., p. 58.

1835. **Sphene.**

Middlefield and Chester, in hornblende slate. Pelham, in gneiss.

E. Hitchcock: Geol. Mass., pp. 381, 398.

1841. **Sphene.**

In hornblende-slate in Middlefield and Chester.

Ibid., p. 624.

1844. **Sphene.** (*Rutilus obliquus.*) Pelham.

J. D. Dana: Sys. Min., p. 421.

1876. **Titanite.** Pelham, Belchertown, Chester.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 7.

1882. **Titanite.** Pelham.

Rare, in pale-yellow to chocolate-colored crystals, 1 mm. to 5 mm. in length; in specimens of feldspar labeled albite by Professor Shepard in Amherst College collection; also in the common gneiss 2 miles north of the asbestos mine in flat, well-formed crystals, and in small grains everywhere in Monson gneiss.

1892. **Titanite.** Pelham.

Honey-yellow crystals (G. = 3.541, Pirsson). Chester, with diaspore.

E. S. Dana: Sys. Min., p. 715.

TOPAZ.

1824. **Topaz** (?). Middlefield, Chester.

Middlefield: Small crystals in serpentine; some prismatic and tetrahedral, yellow, brittle, H. > 7; lying loosely among disintegrated mineral.

Pycnite (subspecies); Chester: In gneiss bowlders; bluish-green, 6-sided prisms terminated by planes, and angles truncated; imperfectly foliated perpendicular to the axis; luster of lateral planes vitreous; infusible; sp. gr. toward 4; less hard than beryl, which it resembles; largest crystal 1¼ by 1¼ inches; several at times united parallel to each other (Emmons).

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 40.

[Not elsewhere cited; the first probably quartz, the second was probably apatite.]

1825. **Pycnite.**

In detached pieces of gneiss resembling beryl.

Robinson's Cat., p. 42.

1825. **Topaz** (?). Goshen.

See Beryl.

E. Hitchcock: Ibid., Vol. IX, p. 180.

TORBERNITE.

1879. **Torbernite.** Chesterfield Hollow.

Associated with spodumene and resulting from change of zircons containing uranium.

A. A. Julien: Spodumene and its alterations; Ann. N. Y. Acad. Sci. and Arts, Vol. I, p. 354.

TOURMALINE.

1811. **Tourmaline.** Goshen.

Lately discovered on estate of Mr. Weeks, of this city, to whom we are indebted for the discovery. (Short description.)

Dr. Bruce: Bruce's Jour., Vol. I, p. 123.

1818. **Schorl**, black. Pelham, Shutesbury, Orange.

E. Hitchcock: Geol. Deerfield; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1819. **Tourmaline.** Chesterfield.

Notes on locality. Discovered by Dr. Hunt.

On tourmalines, etc., at Chesterfield.

Col. G. Gibbs: Ibid., Vol. I, p. 348.

1822. **Tourmaline.** Plainfield.

Good crystals in quartz.

Dr. J. Porter: Ed. note; ibid., Vol. IV, p. 55.

1824. **Tourmaline.** Cummington.

Black in milky quartz; uncommonly fine.

J. Porter: Loc. Min.; ibid., Vol. VII, p. 252.

1824. **Schorl**, blue. Norwich (now Huntington).

Near white rocks one-half mile west and visible from Pitchers Bridge in coarse granite.

E. Emmons: Loc. Min.; ibid., p. 254.

1824. **Tourmaline.** Middlefield, Chester, Norwich.

In granite veins in mica-schist.

Indicolite and green tourmaline in vein of granite in mica schist with silicious feldspar (albite), beryl, prismatic mica, green feldspar, and rose quartz. One green crystal 2 inches long and blue inside; 2 miles south of meetinghouse in Chester (Emmons).

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 42.

1824. **Schorl.** Pelham.

In large masses not regularly crystallized, but exhibiting a crystalline tendency. (At asbestos quarry.)

C. U. Shepard: Loc. Min.; ibid., p. 235.

1826. **Tourmaline.** Worthington.

Well crystallized, radiated, glassy, black, of great elegance. Plainfield.

J. Porter: Min. Not.; ibid., Vol. X, p. 18.

1827. **Schorl.** Williamsburg.

In veins of granite in mica slate and in granite lying contignous to mica slate; terminated. Chesterfield. Frequently stellated.

A. Nash: Lead mines of Hampshire County; Ibid., Vol. XII, p. 259

1828. **Tourmaline.** Chesterfield.

"The vein has been laid open 10 to 12 feet in length. I found Mr. Clark the proprietor, very accommodating and reasonable in his charges for minerals. He will pack boxes for gentlemen at a distance who request it."

E. Hitchcock: Loc. Min.; ibid., Vol. XIV, p. 215.

1828. **Tourmaline.** Norwich (now Huntington).

Near whetstone quarry on west slope of Walnut Hill.

Fine black schorl crystals 1 to 2 inches long and completely covering the convex side of a mass of mica-schist a foot long and 10 inches wide.

E. Hitchcock: Ibid., p. 220.

1829. **Tourmaline**, green. Chesterfield.

Analysis by Gmelin; green variety; sp. gr., 3.102.

BO_2	3.88
SiO_2	33.80
Al_2O_3	39.61
Fe_2O_3	7.31
MnO_2	2.88
NaO	4.95
Loss	.78
	98.33

Ibid., Vol. XV, p. 389.

1835. **Tourmaline.** Chesterfield.

The vein is about 1 foot in width; crystals small, rarely perfect, deeply striated, much curved often, and rifted by cross seams into which the quartz is thrust; green crystals with red center, especially in quartz; single crystals in albite often pure red or green.

C. U. Shepard: Min., Vol. II, 2d ed., p. 245.

1841. **Tourmaline.** Chesterfield.

Many crystals are in a state of internal disintegration; the interior is then often found in a fibrous state.

Teschemacher: Bost. Jour. Nat. Hist., Vol. IV, p. 36.

1841. **Acmite?** Chester.

E. Hitchcock: Geol. Mass., p. 614; also No. 2180 in Cat. of State Col., p. 815, and No. 120, under "Talcose slate," in Final Cat. of State Col. Sixth Ann. Rep. Mass. Board of Agri., App., p. xlv, 1858.

(Referred with doubt to acmite, but finally catalogued as hornblende. It is the black hexagonal tourmaline from the north emery mine.)

1841. **Schorl. Tourmaline.**

Not common in mica-slate; one large slab found in Norwich with crystals standing out upon the surface of the size of a goose quill; generally acuminated. Almost every variety found in the granite; full description given. Common schorl, Pelham.

E. Hitchcock: Geol. Mass., pp. 606, 637, 702.

(The above slab is in the Amherst collection.)

1844. **Tourmaline.** (*Turmalus rhombohedrus.*) Chesterfield, Goshen.

J. D. Dana: Sys. Min., p. 389.

1852. **Tourmaline.** Goshen.

Regular twins; prisms crossing at right angles; rare; a similarity in composition has been observed between the tourmaline and the rock which incloses it; e. g., rubellite in lepidolite; soda-tourmaline in albite.

C. U. Shepard: Min., 3d ed., p. 221.

1860. **Tourmaline.**

Zu Chesterfield in Massachusetts kommen grüne Tourmaline mit rothen Kernen in Topaz vor. (Error.) Seyfert und Söchting (A. A. O., p. 206).

Söchting: Einschlüsse von Mineralien, p. 199.

1865. **Tourmaline.** Chester emery mine.

Highly prevalent throughout the whole vein, especially in North Mountain; more frequent near sides of vein; at some places interlaminated through its entire mass. Crystals often several inches long, fascicular and radiating; longer axis conforming to the bedding; six-sided, unterminated, brownish black.

C. U. Shepard: Report Chester emery mine, p. 11.

1866. **Radiated tourmaline.** Warwick. Grace Mountain.

C. U. Shepard: Am. Jour. Sci., 2d series, Vol. XLII, p. 248.

1866. **Tourmaline.** Chester.

With emery, as at Naxos.

J. L. Smith: Ibid., p. 92.

1876. **Tourmalinite, indicolin, rubellin.**

Tourmalinite: Black, Pelham; green, Chesterfield, Goshen; blue (indicolin), Goshen, Chester; red (rubellin), Chesterfield, Goshen.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst, p. 6.

1882. **Tourmaline.** Northfield, Brush Mountain.

Abundant crystals; termination R,—½ R.

W. E. Webster's collection; Northfield.

1883. **Tourmaline.** Pelham, at the asbestos mine.

Masses of black tourmaline occur 10 to 20 inches across, which afford at times very large imperfect crystals 4 to 8 inches in length, and quite frequently fine, small, perfectly terminated specimens showing the two flat rhombohedra and uniformly a small brilliant 0 P face. These break out of the compact mass of the same mineral, but a film of a compact talc-like mineral surrounds the termination; also small crystals of a deep red-brown occur. The mineral also forms curious micropegmatitic intergrowths with the basic feldspars.

1885. **Tourmaline.** Huntington.

At the new opening for spodumene on Norwich Hill only black tourmaline was found, and that was not abundant. One great crystal 17 inches long, 4.7 inches across at the large end, is nearly cylindrical for two-thirds its length and then tapers in the last third to a rude point, as if a large hand had rudely molded it, the deep imprint of the fingers remaining at the other end. It is terminated by 0 P, the edge of which is replaced by the small faces of a flat rhombohedron.

1891. **Tourmaline.** Chesterfield.

Crystals of tourmaline 1¾ inches across and 4 inches long, mottled green and blue outside, deep green on the inside. From Macomber's ledge; and the finest from this locality are in the collection of Columbia College. They were collected by Mr. A. A. Julien.

1891. **Tourmaline.** Chester.

Quite fine black doubly terminated crystals 1 inch long, short and stout like those from Monroe, Conn. In coarse chlorite schist in railroad cutting near village.

1894. **Tourmaline.** Chester.

The radiated and fasciculite-like tourmaline occurs finely at the new mine just across the road and river to the north of the old mine. I have reexamined the mineral and find its prisms measure 60°. It is uniaxial and deep emerald green by transmitted light. A chemical examination made by Mr. Arthur J. Hopkins, instructor in chemistry, gave silica 32.30 and a strong test for boron. This examination was made because the mineral has recently been called hornblende again, which it much resembles in the smooth faces and hexagonal form of the prisms.

1894. **Tourmaline.** Northfield.

An interesting locality has recently been opened by blasting by Mr. C. H. Webster, of Northfield. Leaving the gulf road at school No. 6, and going east a half mile on the Erving road, and then south a fourth of a

1894. **Tourmaline**—Continued.

mile, the crystals are found in a quartz vein which lies in the line of the great Northfield fault. The crystals are 10 to 20 mm. wide and the longest about 8 cm. long. They are inclosed in white quartz and are much broken and recemented. They show the crystalline faces $\infty R 2$, $\infty R \frac{3}{4}$, ∞R, $-\frac{1}{2} R$, $-2 R$.

1894. **Tourmaline.** Warwick.

High up on Mount Grace in hornblende-schist the mineral occurs abundantly in radiating groups about an inch across of shining black striated needles. It occurs also diverging in both directions from a plane which is only marked by a line of fine black grains and from which the needles go out at right angles. The tourmalines have often absorbed all the iron from the surrounding rock, and a fine granular quartzite slightly tinted by epidote remains.

TREMOLITE.

See Zoisite, 1818, and Amphibole, 1835.

TRIPHYLITE.

1850. **Staurotide.** Norwich (now Huntington).

Spodumene locality on farm of C. Hartwell. Black, semimetallic luster; crystals 1½ inches in breadth. New crystalline form.

J. D. Dana: Am. Jour. Sci., 2d series, Vol. X, p. 121.

1851. **Phosphate of iron, manganese, lithia.** Norwich.

In quartz with spodumene; crystals one-fourth to above an inch in length. At first supposed to be black staurotide, with which it is isomorphous; differs from triphyline in absence of cleavage.

J. D. Dana: On the physical and crystallographical characters of the phosphate of iron, manganese, and lithia of Norwich; Ibid., p. 101.

1851. **Triphylite.** Norwich.

Chemical examination. Sp. gr. 2.876.

	No. 1.	No. 2.
PO_5	41.35	44.04
Fe_2O_3	27.36	26.02
MnO_3	24.70	23.30
Al_2O_3	Trace.	Trace.
LiO	2.27	2.20
CaO	1.97	1.61
MgO	Trace.	Trace.
H_2O	2.07	2.07
	100.01	100.14

$RO,3R_2O_3,3PO_5$.

W. J. Craw: Chemical examination of a phosphate of iron, manganese, and lithia from Norwich, Mass.; ibid., Vol. XI, p. 99.

1852. **Triplite (alluaudite?).** Norwich.

Figured and angles given; considered monoclinic; described.

C. U. Shepard: On the triplite (alluaudite) of Norwich; Proc. Am. Assoc. Adv. Sci., Vol. VI, p. 234.

1853. **Triplite.** Norwich.

The crystals are referred by Shepard to the monoclinic system; angles given.

The above article noticed in Am. Jour. Sci., 2d series, Vol. XV, p. 445. Editor's note. The reviewer defends the rhombic crystallization of the mineral.

1853. **Triphyline.** Norwich.

The triphyline on alteration loses its alkali takes up water and oxygen, the iron and manganese become peroxides. The mineral from Norwich is of this kind.

Scientific intelligence; Am. Jour. Sci., 2d series, Vol. XV, p. 445.

1854. **Phosphate of iron and manganese.**

First observed by Dr. E. Hitchcock, jr., and Mr. Hartwell. Analysis; considered it an altered mineral.

J. W. Mallet: Ibid., Vol. XVIII, p. 33.

1862. **Triphyline.** Norwich.

The center of some of the altered crystals is found to be green and distinctly cleavable and to be triphyline—its first identification in this country.

G. T. Brush: Ibid., Vol. XXXIV, p. 402.

1879. **Triphylite.** Norwich.

Analysis of the unaltered interior of a crystal. Color grayish-green; sp. gr. 3.534.

	No. 1.	No. 2.	No. 3.
P_2O_5	44.72	44.80	44.76
FeO	26.40	26.40	26.40
MnO	17.87	17.80	17.84
CaO	.16	.33	.24
MgO	.49	.45	.47
Li_2O	9.37	9.34	9.36
Na_2O	.32	.38	.35
H_2O	.53	.30	.42
	99.86	99.80	99.84

$Li Fe PO_4$.

S. L. Penfield: Chemical composition of triphylite; ibid., 3d series, Vol. XVII, p. 226.

1891. **Triphylite.** Huntington.

Most of that from Huntington is altered to the center by the peroxidation of the manganese and iron and the removal of most of the lithia. Fine large crystals are sometimes found attached laterally to large spodumene crystals.

URACONITE.

1852. **Uranochre.** Chesterfield.

C. U. Shepard: Min., 3d ed., p. 144.

1879. **Uranochre.** Chesterfield Hollow.

In fissures in spodumene resulting from change of autunite and torbernite.

A. A. Julien: Spodumene and its alterations, p. 354.

URANITE.

See Autunite.

VANADINITE.

1866. **Vanadinite.** Manhan lead mine, Southampton.

The very rare crystals of stolzite are at times partially incrusted by a red-brown somewhat botryoidal mineral, which affords the blowpipe reaction of vanadinite, though the quantity employed in the trial did not permit a complete verification of this inference."

C. U. Shepard: On the scheeletine at the Southampton lead mine; Am. Jour. Sci., 2d series, Vol. XLI, p. 215.

1885. **Vanadinite.**

A careful examination of the reddish-yellow crusts upon the original specimen of stolzite in the Clarke collection in Smith College shows that they are made up of quadratic crystals P (111) $\frac{\infty P 3}{2}$ (π 130) of stolzite or wulfenite; probably the latter.

VERMICULITE.

See Jefferisite.

1882. **Diabantite–vermiculite.** Deerfield. Cheapside Railroad cutting, in trap.

The steps of the process by which the diabantite changes to a vermiculite are given above under Diabantite. The material, although quite characteristic, hardly requires a separate specific name.

B. K. Emerson: The Deerfield dyke and its minerals; Am. Jour. Sci., 3d series, Vol. XXIV, p. 201.

VESUVIANITE.

1824. **Idocrase.**

Hyacinth-red; luster vitreous; fracture uneven (Emmons). Imperfect crystals, sometimes nearly one-fourth of an inch in diameter; prism terminated by low pyramids. Chester, with actinolite, epidote, chlorite; also Worthington (Emmons).

C. Dewey: Geol. Berkshire County; Am. Jour. Sci., 1st series, Vol. VIII, p. 44.

Doubtful occurrence.

VILLARSITE.

1882. **Villarsite.** Pelham.

Much of the chrysolite at the asbestos mine has lost its disseminated ore, become hydrated, and exactly resembles this mineral. It has a pale olive-green color, becomes friable, and the grains are softer than olivine.

VIVIANITE.

1883. **Vivianite.** Hadley.

In the insect-bearing leaf beds which crop out in the east bank of the Connecticut River 100 rods above the bridge over the Fort River, near its mouth. These leaf beds are cross sections of old beds of the Fort River. The vivianite occurs as a replacement of leaf stems, and disseminated in the fine sand in quite large patches. It often coats the wings of insects.

WAD.

1820. **Oxide of manganese.** Deerfield, Leverett.

E. Hitchcock: Am. Jour. Sci., 1st series, Vol. II, p. 374.

1823. **Oxide of manganese.** Leverett.

In alluvial soil forming a bed 5 or 6 inches thick a few inches below the surface; granular. Deerfield, crusts on quartz and mica-slate.

E. Hitchcock: Geol. Conn. River; ibid., Vol. VI, p. 235.

1833. **Oxide of manganese.** Leverett, Whately, Conway.

Up to 1 foot thick.

E. Hitchcock: Geol. Mass., p. 123.

1841. **Oxide of manganese** or **wad.**

Bog deposit in Leverett, Whately, Conway; sometimes up to 1 foot thick. Ibid., p. 318.

1876. **Wad.** Leverett lead mine.

As dendrites and as aggregates in cavities of minute black shining scales, which in a few days lost their high luster and sank into a brownish-black powder having the properties of common wad.

1882. **Wad.** Deerfield.

Occurs scattered over much of the prehnite in dots often massed together over a surface otherwise clean, in long diamond shapes, the shadows of elongated calcite scalenohedra which have disappeared.

B. K. Emerson: The Deerfield dyke; Am. Jour. Sci., 3d series, Vol. XXIV, p. 351.

WASHINGTONINE.

1876. **Menaccanite** var. **washingtonin.** Chester.

C. U. Shepard. Cat. of Min. within 75 miles of Amherst, p. 7.

WASHINGTONITE.

See Menaccanite.

WERNERITE.

1824. **Scapolite.** Chester.

C. Dewey. (See Zoisite, 1824.)

1825. **Scapolite.** Charlemont.

J. Porter. (See Zoisite, 1825.)

1826. **Scapolite.** Goshen.

J. Porter. (See Zoisite, 1826.)

1835. **Scapolite.** Westfield.

C. U. Shepard. (See Oligoclase, 1835.)

Is a coarse granular plagioclase near oligoclase. Specimen preserved in Mass. State Col., Sec. XIII, No. 32. Cat. in Mass. Agri. Rep. 1859, App., p. xlvi.

1841. **Scapolite.** Chester.

E. Hitchcock: Final Rep., p. 606. (See Zoisite, 1824.)

1841. **Scapolite** or **petatite.**

E. Hitchcock: Final Rep., p. 618. (See above, 1835.)

1844. **Scapolite.** (*Scapolus pyramidalis.*) Chester.

J. D. Dana: Sys. Min., p. 357.

WULFENITE.

1811. **Molybdate of lead.** Loudville.

Description.

Wm. Meade: Bruce's Jour., Vol. I, p. 151.

1823. **Molybdate of lead.** Above quoted.

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 234.

1835. **Yellow lead ore.** Pyramidal lead baryta. Loudville.

Rare.

C. U. Shepard, Min., Part II, Vol. II, p. 285.

1885. Wulfenite.

Was obtained in considerable abundance at the last opening of the mine at Loudville. The finest suite of crystals in the Clark collection in Smith College.

Color smoke gray, lemon yellow, orange yellow to yellowish red. The gray, yellow, and orange crystals are present respectively in different crystallographic types. The two former colors are comparatively rare; the orange deepens to a tint only a shade less deep than the Phœnixville crystals. The luster is vitreous to resinous in the red shades; subadamantine in the other colors.

The crystals are distantly attached by their edges to the cavernous quartz, and only very rarely occur in continuous crusts, as at Phœnixville. This appears in the deep-red type, which then can scarcely be distinguished from the Phœnixville occurrence, except by the lesser luster of certain faces. They are thick to thin-tabular, the largest 10 mm. across—average 5 mm. At times a delicate groove is carried around the 0 P face near its edge on P ∞ like the groove around the edge of a book cover; rarely in the smoke-gray crystals a deep claret-colored line occupies the same position and extends through the thickness of the crystal. At times a lemon-colored crystal is increased by an outward band of orange-colored material. The crystals occur in four distinct types. The smoke-gray crystals, which have a shade of yellow in them and are opaque from included foreign substance, are marked by the absence of hemihedral faces and the prevalence of hemimorphism. They are in thin tables and the rims of the crystals are occupied by faces of the zones of P and P ∞ in about equal degree. A few of the clear lemon-yellow crystals are of this type. The largest crystals are $\frac{1}{4}$ inch square.

Combinations represented:

1st. 0 P (001), $\frac{1}{16}$ P ∞ (1, 0, 16), $\frac{1}{12}$ P ∞ (1, 0, 12), $\frac{2}{5}$ P ∞ (205), P ∞ (101), ∞ P ∞ (100), $\frac{1}{3}$ P (113), ∞ P (110), ∞ P 3 (310).

2d. 0 P (001), P (111), $\frac{1}{3}$ P (113), $\frac{1}{16}$ P ∞ (1, 0, 16), P ∞ (101), ∞ P (110); hemimorphic, the other end showing only 0 P (001).

3d. 0 P (001), $\frac{4}{3}$ P (443), $\frac{3}{2}$ P (332), 2 P 221, $\frac{1}{2}$ P ∞ (102), ∞ P ∞ (110), *m* P *n* undetermined; hemimorphic. $\frac{4}{3}$ P (443) is new; angle on 0 P (001) observed 71° 15′; calculated 71° 25′ 4″.

4th. 0 P (001), $\frac{1}{16}$ P (1, 1, 16); hemimorphic: 0 P (001); alone below.

The second type is lemon yellow, thick, tabular, generally neither hemimorphic nor hemidedral, with few faces, and with the P ∞ zone predominant, but the P zone well marked. Combinations are:

1st. 0 P (001), P (111), $\frac{1}{16}$ P (1, 1, 16), $\frac{1}{2}$ P ∞ (102).

2d. 0 P (001), P ∞ (101); hemimorphic: below is 0 P (001), $\frac{\frac{7}{75} P 7}{2}$ (π 7, 1, 75) $\varphi \vee c = 8^\circ 20'$.

The third type is of rich orange-red and very rare. The crystals are almost perfect cubes of the base and the trito-prism $\frac{\infty P 3}{2}$ (π 310) with generally a trace of the second pyramid P ∞ (101). A beautiful specimen covered with cubes of this type is in the cabinet of Smith College. Thick tables with rounded edges may be associated with this type; they seem made up of 0 P (001), ∞ P (110), $\frac{\infty P 3}{2}$ (π 310), P ∞ (101).

The fourth type is by far the most abundant. The crystals are an orange yellow to deep orange—almost red—and are in broad square plates, never very thin, and bounded by the faces of P ∞ (110), which rarely occur alone with 0 P (001), but which are always so predominant as to decide the habit of the crystal. The rounded, polished face of the trito-prism $\frac{\infty P 3}{2}$ (π 310) is rarely absent. P (111) and a long series of other

1885. **Wulfenite**—Continued.

faces appear only in traces. 0 P (001) is, however, generally not a true face, but is made up of a series of flat pyramids.

Typical combinations are:

1st. 0 P (001), P ∞ (101).

2d. 0 P (001), P ∞ (101), P (111).

3d. 0 P (001), P ∞ (101), $\frac{\infty P 3}{2}$ (π 310).

4th. 0 P (001), P ∞ (101), ∞ P 3 (π 310), $\frac{\infty P \frac{6}{5}}{2}$ (π 650).

5th. 0 P (001), P ∞ (101), $\frac{\infty P 3}{2}$ (π 310), $\frac{1}{16}$ P (1, 1, 16), $\frac{1}{12}$ P (1, 1, 12), ∞ P ∞ (100), ∞ P (110), P (111), $\frac{1}{3}$ P (113).

6th. 0 P (001), $\frac{1}{16}$ P ∞ (1, 0, 16), $\frac{\infty P 3}{2}$ (π 310), P ∞ (101); hemimorphic; the other end = O P (001).

7th. 0 P (001), $\frac{1}{12}$ P (1, 1, 12), P ∞ (110), P (111), $\frac{1}{3}$ P (113); hemimorphic; the other end = $\frac{1}{16}$ P (1, 1, 16), 0 P. $\frac{1}{16}$ P ∨ 0 P = 5° 54′; $\frac{1}{12}$ P ∨ 0 P = 7° 27′.

The following is a list of the forms observed, with a word of description of the faces:

2 P (221), d. rare, shining.
$\frac{3}{2}$ P (332), r. rare, shining.
$\frac{4}{3}$ P (443), γ rare, shining (new).
P (111), n. shining, small.
$\frac{1}{3}$ P (113), s. shining, small.
$\frac{1}{12}$ P (1, 1, 12), θ dull, curved (new).
$\frac{1}{16}$ P (1, 1, 16), w dull, curved.
P 3 (131), λ (new).
P ∞ (101), e. most common, large, dull, rarely shining.
$\frac{2}{5}$ P ∞ (205), z. rare.
$\frac{1}{2}$ P ∞ (102), u. dull.
∞ P (110), m. narrow, shining.
∞ P ∞ (100), a. narrow, rough.
0 P (001), c. dull.
∞ P 3 (130), g. common, shining, rounded.
∞ P $\frac{6}{5}$ (650) ν (?), common, notched.
$\frac{7}{75}$ P 7 (7, 1, 75), φ rare, dull.
$\frac{1}{16}$ P ∞ (1, 0, 16) b.
$\frac{1}{12}$ P ∞ (1, 0, 12) β.

The face ∞ P ∞ (100) is rarely present when the rounded $\frac{\infty P 3}{2}$ (π 430) occurs, but in its place a trito-prism turned out but a little from the position of the proto-prism and regularly notched like the so-called milling of a coin by the oscillatory repetition of ∞ P 3 and ∞ P. It can not be measured and I have assigned it doubtfully to ∞ P $\frac{6}{5}$, from which it can not widely differ.

Wulfenites of the yellow type rest on stolzite, and a crust of minute reddish crystals on the same is probably also wulfenite in the form P (111) $\frac{\infty P 3}{2}$ (π 130).

Analysis of the wulfenite detects chromium, but no vanadium. Paragenesis:

1. Calcite,
    Quartz,
        Wulfenite,
            Pyromorphite.

2. Galena,
    Quartz,
        Stolzite,
            Wulfenite.

1885. **Wulfenite**, alteration product of. Manhan lead mine, Loudville.

There is a single specimen in the Clarke collection labeled "Cotunnite, according to Professor Shepard," which possesses the following peculiarities: It is in thin, quadratic, and octagonal plates resembling exactly the thin, pale, yellow type of the wulfenite, but is exteriorly snow-white and opaque; in the interior, however, it is translucent, pale, yellow, with resinous luster.

ZIRCON.

1820. **Zircon.** Brimfield.

In adularia; found in a well near the residence of the late Gen. William Eaton by his daughter. Color of smoky quartz; four-sided prisms with four-sided ends.

A. Eaton: Index, p. 94.

1823. **Zircon.** Brimfield, in gneiss (Eaton).

E. Hitchcock: Geol. Conn. River; Am. Jour. Sci., 1st series, Vol. VI, p. 220.

1825. **Zircon.** Brimfield.

Robinson's Cat., p. 39.

1876. **Zirconite var. cyrtolin.** Ware.

C. U. Shepard: Cat. of Min. within 75 miles of Amherst College, p. 6.

1879. **Zircon.** Chesterfield Hollow.

Rich in uranium; minute double pyramids, rarely three-sixteenths of an inch in diameter; in albitic granite; rare but perfect crystals in quartz, core of vein.

A. A. Julien: Ann. N. Y. Acad. Sci. Arts, Vol. I, p. 351.

1879. **Oerstedite.** West Chesterfield Hollow.

Frequently found in black octahedra, not only implanted on the outer planes of these pseudomorphs, but also inclosed in the yellow mixture of cymatolite and muscovite.

A. A. Julien: Ibid., p. 329.

1879. **Cyrtolite.** Walnut Hill, Huntington.

In albitic granite in central quartz core of vein.

A. A. Julien: Ibid., pp. 327, 351, 352.

1883. **Zircon.** Pelham asbestos quarry.

In tourmaline and compact plagioclase (andesite and anorthite), in Pelham asbestus quarry. Crystals just visible to the eye; bright, transparent, red hyacinths with polished faces, long quadratic prisms doubly and complexly terminated P, 3 P, 3 P 3. These are with the microscope red to olive-green by transmitted, red to amber by reflected, light; also colorless adamantine "jargons," showing with transmitted light a faint reddish tinge.

ZOISITE.

1818. **Tremolite.** West part of Leyden, near Green River.

In mica slate. Very abundant.

E. Hitchcock: Geol. Deerfield Dyke; Am. Jour. Sci., 1st series, Vol. I, p. 114.

1823. **Tremolite, Zoisite.** Leyden.

"A mineral has been found at Leyden in great quantities associated with quartz, limestone, etc., and sometimes forming the gangue of the red oxyd of titanium. * * * Also at Colerain (?), at Shelburne (?), at Conway (?),

1823. **Tremolite, Zoisite**—Continued.

at Goshen, and in various instances in vast abundance. This mineral has generally been called tremolite, and sometimes zoisite, but it is probably scapolite."

E. Hitchcock: Geol. Conn. River.; ibid., Vol. VI, pp. 223, 225.

1824. **Scapolite.** Goshen.

Scapolite of a silver-gray color associated with quartz. The surface of the crystals is longitudinally striated and generally dull, but on being broken they exhibit a structure distinctly foliated with a shining luster. Published as tremolite in Vol. VI, Am Jour. Sci.

J. Porter: Loc. Min.; ibid., Vol. VII, p. 252.

1824. **Zoisite.** Chester.

Gray, flattened prisms, striated.

C. Dewey: Geol. Berkshire County; ibid., Vol. VIII, p. 44.

1824. **Scapolite.** Chester.

Gray and white; pearly luster; scratches glass; sometimes four-sided prisms; generally irregular, often intersecting variously; melts to porous yellow-white glass with ease. Chester, with hornblende, augite, etc.; resembles tremolite.

C. Dewey: Geol. Berkshire County; ibid., 1st series, Vol. VIII, p. 44.

1824. **Scapolite.** Southwest of Goshen.

Crystals several inches long. Surface striated, foliated; longitudinal fracture, shining, even; a metallic luster, the color a lively silver-gray; splintery crystals sometimes curved and crystals curiously interlaced; some smaller crystals with shining faces and nearly transparent. Here, as in Chesterfield, in white quartz.

J. Porter: Ibid., Vol. VIII, p. 233.

1825. **Zoisite.** Hawley, near Iron Works.

In veins of quartz in hornblende rock. "It surpasses in beauty any which I ever beheld."

C. U. Shepard: Bost. Jour. Phil. and Arts, Vol. III, p. 609.

1825. **Scapolite.**

Very abundant by the roadside about a mile east of Hall's Tavern, Charlemont (Dr. H. M. Wells, of Windsor).

J. Porter: Loc. Min.; ibid., Vol. IX, p. 54.

1826. **Zoisite.** Worthington.

Remarkably beautiful.

J. Porter: Am. Jour. Sci., Vol. X, p. 18.

1826. **Scapolite.** Goshen.

J. Porter: Ibid., Vol. X, p. 18.

1827. **Zoisite.** Worthington, Conway, Chesterfield.

A. Nash: Lead mines of Hampshire County; Am. Jour. Sci., 1st series, Vol. XII, p. 259.

1828. **Zoisite.** Hawley (C. U. Shepard), Chester, Leyden.

Dirty gray with rutile.

Robinson's Cat., pp. 42, 57.

1828. **Zoisite.** Chesterfield.

One mile north of meetinghouse on land of Mr. Searl.

With kyanite and anthophyllite.

E. Hitchcock: Loc. Min.; ibid., Vol. XIV, p. 216.

1835. **Zoisite**. Goshen, Hawley, Middlefield, Chester, Chesterfield, Conway, Windsor, and especially in large quantities in North Leyden.

E. Hitchcock: Geol. Mass., p. 346.

1835. **Zoisite**. Hawley.

Very beautiful gray crystals of small diameter compared with their length, at Hawley, penetrating small beds of quartz in hornblende rock. Goshen and Williamsburg in veins in granite in mica-slate.

C. U. Shepard: Min., 1st edition, Vol. II, p. 184.

1836. **Zoisite**. Williamsburg.

SiO_2	40.21
Al_2O_3	25.59
Fe_2O_3	8.55
CaO	23.28
H_2O	1.71
	99.34

T. Thompson: Outlines Min., Vol., I, p. 271.

1841. **Zoisite**. Goshen, Hawley, Middlefield, Chesterfield, Conway, especially Heath and north part of Leyden.

E. Hitchcock: Geol. Mass., p. 606.

1841. **Scapolite**. Chester (Emmons).

In veins in mica slate associated with hornblende, pyroxene, and garnet, but the crystallization is generally confused and indistinct (Emmons's Min.).

E. Hitchcock: Geol. Mass., p. 606.

1844. **Epidote** (**Zoisite**). (*Carbunculus rhombohedrus.*) Chester, Chesterfield, Heath, Leyden, Williamsburg.

J. D. Dana: Sys. Min., p. 379.

1857. **Zoisite**. Goshen.

Analysis.

SiO_2	40.06
Al_2O_3	30.67
Fe_2O_3	2.45
CaO	23.91
MgO	.49
H_2O	2.25
	99.83
Sp. gr	3.341

C. Rammelsberg: Pogg. Ann., C., p. 133.

1876. **Zoisite**. Pelham.

Small, thin, nearly transparent, colorless crystals, much resembling euclasite in form; also in columnar aggregations; both varieties embedded in crystals of black tourmalinite. H. 6.5; sp. gr. 3.3; before the blowpipe like zoisite.

SiO_2	42.20
CaO	22.00
Fe_2O	7.10
MgO	2.08

C. U. Shepard: Contrib. to Min. (priv. pub.), p. 4.

1880. **Zoisite.** Williamsburg.

There is a magnificent zoisite in the Smith College collection: an eight-sided gray prism 1¼ inches in diameter, 2 inches long, with feldspar in center, and associated with chlorite.

1881. **Zoisite.** Williamsburg.

WILLIAMSBURG, *January 27, 1881.*

DEAR SIR: Yours received this day. Plumose mica abounds on what is known here as Gear Hill, about 1 mile northwest, near the hamlet called Searsville. I have found it plentiful there for some sixty years, and have supposed it the best locality known. Found only within the circuit of a few hundred acres.

Epidote or zoisite last procured by me was found 4 miles hence on the Ashfield road, upon land owned by Andrew I. Hitchcock. A large bowlder full of it, associated with hornblende schist, has been thoroughly broken up, mostly carried away, I think. I have not explored for it much in this region. I merely have a Yankee guess it may be found near by there.

Many years since I have found it in various places in Goshen; also found it in Worthington; a few most beautiful crystals. Now I should not know where to find it in this town of Worthington.

You can find a large mass of it on land of Elisha Mason, some 3 miles west of the East Village in Cummington. Mr. Robbins, in East Village, or A. C. Chapin, in the West Village, are excellent guides or directors.

In the same range we find it in Colerain, and in Halifax, Vt. In Colerain, near Heath line, on land near Anson Dwight, who knows the place. I have a hundred-pound mass of it rolled up on a bank for someone's use.

Yours, truly.

MORRIS DWIGHT.

1882. **Zoisite.** Pelham asbestos mine.

Embedded in massive tourmaline; sp.gr. 3 to 3.2; H. 7.5; before the blowpipe fusible to blebby green glass.

Analysis.

SiO_2	41.27
Al_2O_3	12.20
Fe_2O_3	9.82
CaO	23.20
MgO	2.08

Analysis unpublished.

C. U. Shepard, 1875.

(In small, elongate crystals 1 inch in length, of yellowish color, and in colorless masses with radiate columnar structure. In the last opening of the mine the mineral was found in highly lustrous, transparent prisms a half inch across, colorless and completely fresh. It was embedded in black biotite.)

1887. **Zoisite.** Shelburne Falls.

From large bowlders in a well; large, foliated masses of the finest light-pearl gray; stout prisms; not terminated, and smaller blades interlaced with quartz to form a rock.

In collection of Amherst College.

1890. **Zoisite.** Shelburne.

Three-quarters of a mile northeast of Center, south of Charles Smith's place.

Large bowlders north of road to Center. Many terminated crystals, very simple and untwinned; gray, changing to transparent hyacinth red at termination.

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DATE DUE	BORROWER'S NAME
OCT 14 '77	~~C.A. FRANCIS~~
[illegible] 30 '79	~~C.A. FRANCIS~~
FEB 7 '80	~~C. Francis~~
[illegible] 83	~~C.A. Francis~~

U.S.G. [illegible]
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